The impact of the early frontal lobe damage on the development of executive functions

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AGING

T. KOGURE & T. HATTA. Temporal Memory Illusion of Social Events in Older and Younger Adults.
Even though people could remember precise contents of a social event (e.g., news event) that happened previously, the time of the event occurrence could hardly be retrieved accurately. People sometimes estimate the time of occurrence more recently than the actual time (telescoping bias), while they sometimes, in contrast, estimate the time of occurrence more remotely than the actual time (time expansion bias). The present study examined aging effects of these temporal memory illusions. Participants were 20 older and 40 young adults. Older adults were those who were more than 60 years old (*M* age = 70.1) and all community dwelling. Young adults were nurse college students (*M* age = 20.0). Thirty news events that happened during 1985–1999 were selected as question items (2 events were selected for each year). This experiment was conducted on a group in June (older) and December (young) 2000. Each participant was given a booklet and required to read the brief description of each news event and to estimate the date (year) of occurrence. They were encouraged to estimate it as it first came to mind. The results indicate that young adults tend to have time expansion bias only in the events that happened 3–1 years ago, whereas, older adults in contrast, tend to have this bias in the events that happened 6–1 years ago. These results suggest aging effects on temporal memory illusions of social news events; that is, older adults are more retrospectively biased with respect to time expansion than are young adults.
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C.E. McGRATH, P. J. MOBERG, & G.D. PEARLSON. Odor, Verbal, and Visual Recognition Discrimination and Response Bias Across the Life-Span.
Age-related decline in verbal and visual memory has been well documented in healthy adults, but less is known about memory for odors. The study of odor memory is complicated by the fact that it is thought to integrate primary olfactory function and higher cognitive processes. Older adults demonstrate increased odor thresholds compared to younger cohorts; thus, if age-related changes in odor memory are found, it is unclear to what degree the differences are due to primary olfactory function, cognitive processes, or both. The current study addressed this methodological issue by studying olfactory, verbal, and figural recognition in 110 healthy adults (age range 18–83, *M* age = 49.65 years), all of whom passed a 3-stage odor discrimination test prior to participation. Multivariate analyses revealed a decline in recognition accuracy with age across all 3 domains, with less impairment in figural memory among individuals older than 60. Moreover, age-related changes in odor memory were not related to changes in verbal or figural recognition. On the figural recognition task, older individuals demonstrated more liberal response biases than did younger participants. Age-related differences in recognition discrimination and response bias were not accounted for by global cognitive function, smoking history, sex, or ethnicity. These findings suggest that odor recognition declines with age, even among individuals with generally intact olfactory acuity.
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M. LEWIS & L.S. MILLER. Performance-Based Measures as Most Reflective of Real-World Functional Ability and Executive Control Functioning.
Past research has demonstrated that deficits in executive control functioning (ECF) are related to functional deficits in older adults. The strength and nature of this relationship differs according to whether functional ability is measured using performance-based scales or self-report scales of ability. In the current study, 60 older adults were administered an overall screen of ECF, the Executive Interview (EXIT; Royall, 1989), neuropsychological tests tapping into cognitive ability, a performance-based scale of functional ability, the Direct Assessment of Functional Status (DAFS; Lowenstein 1992), and a self-report measure of function, the Older Americans Resources and Service Scale (OARS; Duke University, 1978). Data analyses revealed that, although performance on the EXIT was related to both measures of functional status, only performance-based functional ability was significantly related to cognitive performance on neuropsychological tests in multiple regression analyses (multiple $R = .69$, adjusted $R^2 = .43$, $F(4,51) = 10.49$, $p < .001$). Performance-based functional ability and self-reports of functional ability were related to one another, but only moderately so ($r = .423$, $p < .01$). Furthermore, impairment on the DAFS did not significantly predict self-reports of impairment on ADLs ($F(10,49) = 1.876$, $p = .072$), and was only minimally related to self-reports of IADL impairment ($F(10,49) = 2.043$, $p = .049$). Such findings indicate that self-report and performance-based measures of functional ability may be measuring different basic constructs. Performance-based measures may be most reflective of real world ability, ECF, and cognitive status, while self-reports may be reflective of motivation or participant perception.
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N. SILVERBERG & H. TUOKKO. Cognitive Impairment, No Dementia: Criteria and Validation.

Existing clinical labels used to define cognitively impaired elderly persons suffer from several shortcomings, including being overly restrictive, unreliable, and often inappropriate. The present study offers criteria for objectively validated cognitive impairment that may not only circumvent these limitations, but also possess several unique advantages. The criteria set encompasses a broader and more heterogeneous range of impaired individuals, is not limited to amnesic deficits, is comparable across samples, has the possibility for uniform application, and is more specific to decliners. The validation process involved the application of the criteria to participants in the longitudinal Canadian Study of Health and Aging. This process revealed strong concurrent validity, as meeting objective cognitive impairment criteria was found to be related to both poor global cognitive functioning and greater impairment in activities of daily living. As well, good predictive validity was demonstrated in the relationship of the criteria to the 5-year outcomes of further cognitive loss, progression to dementia, institutionalization, and death. Further regression analysis yielded significant contributions of all of the individual criteria to the prediction of the studied outcomes. The proposed criteria appear to be a sensitive and valid approach to detecting mild cognitive impairment in aging individuals, while its reliability remains to be determined.

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T. JONES, L. RAPPORT, P. LICHTENBERG, & R. HANKS. Cognitive and Psychosocial Predictors of Subjective Well-Being in Older Adults.

An important aspect of research examining persons aged 65 and older has focused on factors that influence perceptions of subjective well-being among older adults. Prior research indicates that physical health and various aspects of social support have substantial influences on subjective well-being among the elderly. Unfortunately, much of the research in these areas is hampered by methodological problems, including imprecise definitions of terms, the use of measures with poor psychometric properties, and incomplete assessment of the constructs of interest. This study investigated the cognitive and psychosocial predictors of subjective well-being among adults 65 years of age and older. Participants were 129 community dwelling older adults ages 65 to 89 years of age (66% female, *M* age of 75 years) who volunteered participation through 1 of 6 senior centers in the Detroit metropolitan area. Cognitive and psychosocial measures were used for their ability to predict subjective well-being. Results indicated that these variables are important in predicting happiness independent of demographic variables. Evidence from this study suggests that the use of emotion-focused coping and lack of perceived health was associated with diminished perceptions of well-being. Lack of perceived health had a more negative impact on perceptions of well-being than actual health status. Social support quantity and quality were both equivocally important to happiness. Higher cognitive functioning was also related to life satisfaction and pleasant emotions. Education was found to moderate the influence of cognitive status on subjective well-being.

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O. REY & L. MURRAY. Effects of Test Variations on Elderly Adults Attention Performances.

Attention is an important neuropsychological function that regulates the cognitive resources necessary to process and use acquired information. The Test of Everyday Attention (TEA; Robertson et al., 1996) is a commonly used tool for the assessment of different attentional systems in subjects between 18 and 80 years of age. In this study, we evaluated a group of 37 healthy adults older than 75 years, with normal or corrected to normal vision and hearing, and scores higher than 26 on the MMSE (Folstein et al., 1975). Subjects were given both standardized and experimental versions of 2 TEA subtests. The Visual Elevator Task (VET) was modified in terms of scoring procedure: Participants received independent credit for each individual shift of attention instead of one score based on the participant's final answer for each item. The Elevator Task with Reversal (ETR) was altered to allow more time between the auditory stimuli, while keeping a fixed stimulus presentation speed. Results from the modified VET showed that the elderly subjects obtained higher scores when given independent credit for each correct attention shift, and that compared the standardized VET, these results had a stronger correlation with their performance of other TEA subtests. A comparison of data obtained from the standardized and experimental ETR showed improved performance on the subtest when time between stimuli was increased (i.e., experimental version). These results suggest that controlling test conditions and examining for differences in processing speed allow a more precise assessment of attentional processes in the older population.

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D. HIGGINS, J. WILLIAMSON, & D. HARRISON. A Cross-Sectional Comparison of Frontal Lobe Development and Aging.

This study assessed the influence of age (15 right-handed male children, 14 right-handed college students, and 14 right-handed elderly men) on cerebral laterality. Previous research findings indicate that the frontal lobe functions are the first to deteriorate through the normal aging process. Further, support, though mixed, for right-frontal aging has been found among the results of previous research findings. Perseveration, an inability to discontinue an initiated action, has been well documented with deterioration, lesion, or relative dysfunction of the frontal lobes. Motor perseverations are common as premotor, motor, dorsolateral frontal, and orbital frontal regions share intimate connections. A hand dynamometer was used as a standardized measure of lateralized hemispheric functioning. Perseveration was assessed by requesting the subject to squeeze the dynamometer one-half as hard as their initial full strength effort. The amount of overshoot past one-half was designated as perseveration. Geriatric men displayed significantly more perseveration, or overshoot, than did the college-aged males, and male children, who were fairly accurate. These results were predicted, and suggest relative anterior cerebral activity differences between the 3 groups. In accordance with theories on frontal lobe deterioration with age, geriatric men performed poorly on the perseveration task, relative to the other 2 groups. However, asymmetries were not evidenced which is counter to the right hemi-aging hypothesis. These results are discussed from a functional cerebral systems approach and contribute to the literature in delineating more specifically frontal systems affected by age.

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P.V. REKKAS & S. MURTHA. Slower Reaction Time But Fewer Errors: Prepotent Inhibition in the Elderly.

The hypothesis that the elderly are not as adept at inhibiting prepotent responses was examined using a modified inhibition task based on Diamond, O'Craven, and Savoy (1998). Stimuli were individually presented on the extreme left or extreme right hand side of the screen. Ss hands were placed on designated keys also on the extreme left and right side of the keyboard. In congruent trials, Ss were asked to press the key directly beneath the stimulus, while for incongruent trials they were asked to press the key on the opposite side of the stimulus. Incongruent trials would require inhibition of the impulse to press the key located directly under the stimulus. We predicted that the elderly would take significantly longer on incongruent trials (across arrow and checkered circle) then those that did not (straight arrow and solid black circle). We also predicted that trials that involved a memory component (solid black and checkered circle) would impair performance across age groups. Thirty young and 28 elderly participants were administered the 4 components of the task. Controlling for simple reaction time, both groups performed worse on the memory conditions (solid black and checkered circles). However, only the elderly were significantly slower on trials that called for inhibition, confirming the hypothesis that they would be uniquely challenged by this demand.

Analysis of the error data revealed that the young group produced twice as many errors in the memory condition on congruent trials (solid black circle) than the elderly group, suggesting that the young, but not the elderly, maintained an active state of inhibition on this task.
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J.L. WOODARD, S.K. MILLER, C. LEVERONI, K. DOUVILLE, K.A. NIELSON, M. SEIDENBERG, & S. RAO. Age Differences in Recall of Famous Names: Impact of Familiarity, Frequency of Exposure, and Semantic Knowledge.
This study investigated the relative contributions of familiarity, semantic knowledge, and frequency of exposure on incidental recall of famous names. Eight healthy older participants (mean age = 72.6, *SD* = 5.4) and 18 healthy younger participants (mean age = 23.7, *SD* = 2.6) viewed a series of names of individuals who: (1) became famous in the 1990's; (2) became famous between 1950 and 1970 and are still well-known today (e.g., Marilyn Monroe); (3) achieved a briefer period of fame between 1950 and 1970 (e.g., Pier Angeli); and (4) are not famous. Our behavioral analyses focused on the first 2 fame categories. Names were presented as part of an fMRI scanning protocol at the rate of 4 sec/name, at which time participants indicated by button press if they recognized the name as famous or not. Outside the scanner, participants were asked to recall as many of the previously presented names as possible. Participants were then given a list of previously presented names and were asked to indicate whether each name was famous and to rate the degree of semantic knowledge and the frequency of exposure to the name over the last year. Older participants recalled fewer names than younger participants, although their recognition accuracy and frequency of exposure significantly exceeded that of younger persons. Semantic knowledge ratings did not differ between groups. Results suggest that the recall deficit for older persons is associated with a breakdown in retrieval efficiency as opposed to loss of semantic knowledge with advanced age.
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A. DI FRANCESCO, N. JOHNSON, & S. WEINTRAUB. Level of Daily Activity in Normal Control and Mild Cognitive Impairment Subjects.
Much recent research has been devoted to the preclinical assessment of Alzheimer's disease and possible preventive strategies. Level of everyday activity has been shown to be a useful factor in monitoring cognitive functioning in the elderly. This study used the Adelaide Activities Profile (AAP), a standardized measure of activity specifically developed for a nondemented population, to determine if activity level scores could differentiate between cognitively healthy elderly individuals (NC) and those with mild cognitive impairment (MCI), a risk factor for the subsequent development of dementia. All subjects ($N = 336$) were nondemented volunteers from the Northwestern Alzeheimer's Disease Center registry. The group was further divided into normal controls (NC = 210), subjects who scored normally on neuropsychological tests and had no subjective memory complaints, and an MCI ($N = 126$) group, composed of subjects who scored 2 standard deviations below age and education matched norms on at least 2 neuropsychological tests. Data analysis (ANCOVA) using education as a covariate, revealed average total AAP scores were significantly lower for the MCI group compared to NC. When test items comprising subscales of the AAP were examined, differences in activity level scores were found to be due to significantly lower scores for MCI subjects on the "household maintenance" subscale. The questions comprising this subscale refer to activities that are more rigorous physically than those of the other AAP subscales. These results suggest that a reduction in rigorous physical activity may be another marker of decline in subjects who are at risk for dementia.
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B. DAVID, L. LITTRELL, A. KASZNIAK, & L. NIELSEN. Emotional Experience and Aging.
This study examined possible age-related differences in subjective experience, facial muscle, and autonomic physiological reactions to emotionally evocative stimuli. Fifty-five healthy adult subjects (16 young, 20 middle-aged, and 19 old) were tested; skin conductance response (SCR), facial (bilateral zygomatic and corrugator) surface electromyography (EMG), and subjective ratings of experienced emotional valence and arousal were recorded during the viewing of the International Affective Picture Series slides. The 3 age groups did not vary in their subjective valence and arousal experience ratings. Also, there was not an age effect or any age by slide-type (positive, neutral, negative) interaction with respect to the corrugator and zygomatic muscle activity in response to the stimuli. There was, however, a nonsignificant trend ($p = .12$) for older subjects showing lower skin conductance to all presented categories of stimuli when compared to younger and middle-aged subjects. Overall, the present results indicate age invariance in the subjective, facial muscle, and sympathetic-autonomic responses to emotional scenes. These results extend previous research showing that emotionally salient stimuli do not affect older subjects any differently than younger or middle-aged subjects on the measures of facial EMG, and subjective ratings. Results are discussed in relationship to the broader literature on emotion and aging.
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C.A. MUNRO & J.A. SAXTON. Cognitive Test Performance in Older Alcoholics Is Not Related to Liver Functioning.
Chronic liver disease has been proposed to explain the poor neuropsychological test performance often observed in alcoholics, yet among middle-aged alcoholics, an association between liver function tests and cognitive test performance has not been consistently demonstrated. Furthermore, this association has not been investigated in older alcoholics, who are particularly vulnerable to the effects of alcohol on both the liver and on cognitive test performance, and in whom the association between cognitive test performance and liver functioning might be most evident. This study tested the hypothesis that among older alcoholics, poorer cognitive test performance would be related to laboratory markers of poorer liver function. Thirty-one noncirrhotic alcoholic subjects (age 55–83), abstinent for at least 4 weeks, received a battery of neuropsychological tests and the following liver function tests: alanine transaminase (ALT), aspartate transaminase (AST), bilirubin, and albumin. No correlation was revealed between liver function values and neuropsychological test scores. Because 10 subjects demonstrated significant impairments on cognitive testing such that they met criteria for alcohol dementia, their liver function values were compared to those of the nonimpaired group to test determine if there might be a "threshold" effect of liver function such that once a degree of liver disease is reached, cognitive functioning is impaired. This examination revealed no differences between the two groups. These results suggest that among noncirrhotic older alcoholics, poor cognitive functioning cannot be attributable to poor liver functioning. Furthermore, there does not appear to be a threshold of liver functioning beyond which older alcoholics will exhibit dementia.
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N. CHAYTOR & M. SCHMITTER-EDGECOMBE. Working Memory and Aging: A Cross-Sectional and Longitudinal Analysis.
Older adults often report experiencing increased difficultly completing complex everyday tasks, and working memory has been implicated in some of these difficulties. Several theories have been postulated to explain age-related decline in working memory, including deficits in inhibition, processing speed, monitoring, and strategy use. The current study investigates the relative contribution of each of these theories to age changes in working memory, using both cross-sectional and longitudinal designs. Working memory was assessed using the abstract design version of the Self-Ordered Pointing Task (SOPT). A sample of 140 younger and 140

older adults were participants in Experiment 1. Experiment 1 revealed that although processing speed and strategy use were important components of the SOPT, only monitoring explained age differences in performance. Participants in Experiment 2 were 53 older adults who returned 4 years after the initial testing and 53 young adults. A new task was developed to assess the ability to generate and monitor an internal series of responses versus the ability to follow an externally imposed series of responses. Experiment 2 also investigated the influences of processing speed and monitoring on longitudinal changes in SOPT performance over time. Consistent with Experiment 1, monitoring was found to be the only variable significantly related to age-related change in SOPT performance. The findings are discussed in terms of several predominant theories of working memory and aging.

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J. MANDZIA, S. GRAHAM, M.P. McANDREWS, C. GRADY, & S. BLACK. Non-Verbal Memory in Mild Cognitive Impairment and Healthy Aging: An fMRI Study.

Individuals with mild cognitive impairment (MCI) suffer from greater than normal memory loss for their age, but do not meet the criteria for dementia where only a proportion of them progress to Alzheimer's disease (AD). fMRI may be a useful tool in identifying functional abnormalities in these individuals who are at greater risk of progression. We examined the effects of levels of processing using fMRI during incidental encoding and retrieval of photographs in a group of MCI ($n = 5$) and elderly normal controls (NC) ($n = 9$). Participants performed deep (natural *vs.* manmade decision) and shallow (color *vs.* black & white decision) encoding followed by recognition (deep and shallow) and decided if the photograph was old or new. MCI performed significantly worse than NC during both encoding and retrieval conditions. Reaction time (RT) for deep retrieval was significantly faster than shallow retrieval in NC, but not MCI. fMRI group activation patterns differed depending on memory condition and group membership. For deep encoding, the MCI group demonstrated less medial temporal activity. Both MCI and NC engaged in greater left prefrontal activity during deep *versus* shallow encoding. During both retrieval conditions, the MCI group demonstrated less prefrontal activity. The deep *versus* shallow retrieval ANOVA contrast in the NC group revealed increased bilateral hippocampal activation ($p < .05$). The MCI group failed to demonstrate hippocampal activation in both retrieval conditions. This work suggests that fMRI can reveal differences in activation patterns between MCI and NC, where the MCI did not benefit from the levels of processing manipulation.

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A.C. ROSEN, M. PRULL, J.D.E. GABRIELI, T. STAUB, R. O'HARA, L. FRIEDMAN, J. YESAVAGE, & L. DETOLEDO-MORRELL. Entorhinal Volume Correlates with Mildly Impaired Verbal Memory in Older Adults.

Entorhinal and hippocampal volumes were measured on 14 community-dwelling older adults who, 2 years prior to the current study, participated in a memory-training program. Two groups of adults were selected based on their high ($n = 8$) or low ($n = 6$) abilities on tests of memory recall at the time of study entry. Cognitive testing at the time of structural imaging confirmed the group difference in verbal memory performance in the absence of other deficits. A jack-knife approach was applied to compare the relative strength of the correlations between memory performance and regions of interest. Left entorhinal cortical volume showed the strongest correlation ($r = .79$) with immediate recall of a word list (CERAD). These results suggest that entorhinal cortex atrophy may play an important role in verbal memory decline in minimally impaired, community dwelling older adults.

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H. TUOKKO, D. GARRETT, M. MASSON, & D. BUB. Detecting Dementia in Older Adults with High Educational Attainment.

Diagnosing an incipient dementia in high functioning persons can be extremely difficult (Naugle, Cullum, and Bigler, 1990; Rentz et al., 2000). To address this issue, we used data from the Canadian Study of Health and Aging (CSHA), a nationwide epidemiological study of dementia. Relations were examined between educational attainment and dementia diagnosis at CSHA-1, and after 5 years (CSHA-2) for persons with no cognitive impairment (NCI) at CSHA-1. Formal educational attainment was classified as low (0–5 years), medium (6–12 years), or high (13+ years). At CSHA-1, persons with high education were equally likely to receive a diagnosis of dementia (33.3%; 124/372) as persons with low (34.8%; 199/572) education. Of those with NCI at CSHA-1 who were seen at CSHA-2, a smaller proportion of the highly educated group (9.7%, 10/103) were diagnosed with dementia than the group with low educational attainment (21.2%; 18/85). When performance on CSHA-1 neuropsychological measures was examined for those highly educated persons with dementia at CSHA-2, most people had scores falling in the low average range. It is unclear whether the low incidence of dementia in high functioning persons is evidence for a protective effect of education or is due to some limitation in diagnostic procedures (e.g., the lack of available education-adjusted norms). This study highlights the need for a large scale, longitudinal study of high functioning older adults to fully address this question.

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J. GRIGSBY, S. SHETTERLY, K. KAYE, J. BAXTER, & R. HAMMAN. Incidence and Worsening of Executive Deficits Among the Elderly in a Population-Based Study.

We assessed the incidence of dysexecutive syndrome, and worsening of executive cognitive functioning, in the San Luis Valley Health and Aging Study (SLVHAS), an epidemiologic study among Hispanic and non-Hispanic white elderly in rural southern Colorado. We previously found a prevalence of executive impairment of 33% in the SLVHAS; 16% had moderate or severe deficits. The sample consisted of 1,112 community-dwelling persons and nursing home residents aged 60 to 99 who completed both baseline and follow-up interviews (mean of 21 months). The Behavioral Dyscontrol Scale (BDS) measured the ability to engage in goal-directed, purposeful activity. We obtained data on 1,355 persons at baseline: 119 died before follow-up, and 66 of these were impaired at baseline, with 29 severely impaired, and 82 refused a follow-up interview. The follow-up sample was 59.5% female and 57.6% Hispanic. Of 604 persons not impaired at baseline, 108 had mild, 36 had moderate, and 10 had severe deficits at follow-up; 64 persons, mildly impaired at baseline, improved to the normal range by follow-up, as did 6 moderately impaired persons. Overall, 22.6% declined by $\geq$1 categories; 10% improved by $\geq$1 categories. Mean BDS score change was -1.03, or about -0.25 *SD* for the sample. Multiple regression estimated change in BDS score over time, controlling for age, ethnicity, gender, and education. With $R^2 = 0.15$, all covariates but gender accounted for a significant percentage of the decrease. Less education, Hispanic ethnicity, and older age predicted greater decline. Mean BDS decline across the 21 months was 0.42 points for ages 65–69, 1.38 for ages 75–79, and 3.19 for those over 84.

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S. BELL McGINTY, R. NEBES, C. CIDIS MELTZER, S. MILLER, T. YUFIK, & J.T. BECKER. Functional Neuroanatomy of Semantic Memory as a Function of Aging.

Functional neuroimaging studies of young adults and neuropsychological data from brain damaged patients have consistently implicated the left inferior temporal cortex and inferior frontal regions as being critical for semantic information processing. In particular, when identifying a relationship between 2 drawings, young subjects have increases in blood flow

in the parahippocampal gyrus and inferior frontal lobes. Previous data from older adults suggests a similar activation pattern, yet with greater inferior frontal activation and a lower magnitude of activation in the posterior temporal regions. The purpose of this study was to examine the extent that functional neuroanatomy of semantic memory changes as a function of aging. Positron emission tomography (PET) scans were obtained on 8, healthy elderly subjects and 8, healthy young subjects to compare relative cerebral blood flow during performance on 5 visual tasks: visual baseline, figure matching, size matching, group matching, and semantic matching (Pyramids and Palm Trees). The resulting relCBF maps were analyzed using SPM99. Results indicated that elderly subjects did not show significant activation in the parahippocampal gyrus as was observed in young subjects. By contrast, activation in the inferior frontal cortex was observed in both young and old subjects, although the extent of the activation was decreased in the older subjects. These data add to the growing body of evidence that there is a significant alteration in temporal lobe function in the elderly. The reductions observed in activation suggest some functional reallocation of resources to permit the elderly subjects to continue to perform the tasks accurately.

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L.A. DADE, J.F. HAY, K.E.B. DENNIS, K.A. PHILP, E. SVOBODA, & B. LEVINE. Name That Tune: Songs as Episodic and Semantic Memory Cues in Retrograde Amnesia.

Retrograde amnesia (RA) can be classified as a deficit of episodic memory, semantic memory, or a combination of the two. Subject A.F. reported RA for a 4-year period predating a severe traumatic brain injury. A new test was created to more precisely characterize the episodic and semantic components of A.F.'s memory deficit. Songs that had ranked in the top 40 and were time-locked to a particular year (due to their inherent fading popularity) were selected as cues for retrieval of episodic memories (personal experiences specific in time and place) and semantic memories (factual information about the song title, artist, or lyrics). Songs to which A.F. had been re-exposed since the accident were excluded. The format of this song recognition test allowed investigation of the time course of memory deficits across various pre-traumatic and post-traumatic periods. Ten healthy matched controls were also tested. Subjects listened to excerpts of songs, responded with episodic and semantic information and completed a recognition question and a familiarity rating. Results indicated a specific and substantial episodic memory deficit in patient A.F. All control subjects had a greater number of episodic memories triggered by the songs than A.F. Overall, she demonstrated better retention of semantic information than episodic, being able to sing along with several songs, and correctly recognize artists and titles. These results are considered in relation to data from other measures of autobiographical memory and detailed analysis of A.F.'s MRI.

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C.C. PERSAD & R.T. ZACKS. The Role of Inhibition in Working Memory Performance Associated With Age.

The current investigation addressed the view that inefficient inhibitory processes account for some of the age-related declines in performance on measures of working memory (WM). WM measures were chosen from the neuroimaging literature. This study examined age differences between a young (18–29) a young-old (60–74) and an old-old group (75+) on versions of the n-back and item recognition tasks (Jonides et al. 1998; Smith & Jonides, 1997). The tasks included critical trials for which it was presumed that inhibitory processes were particularly important for successful performance. According to the inhibitory deficit view, older participants should show particular difficulty on these trials. Results generally supported this hypothesis. Not only did the older adults have more difficulty than the young adults on these tasks overall, they also showed relatively more difficulty on those trials that were theorized to rely more on the integrity of inhibitory processes for successful performance. No differences were found between the 2 older groups. This study also addressed the suggestion of some researchers that inhibition is partly subserved by the prefrontal cortex (PFC). In particular, performance on the WCST, often described as a putative measure of frontal lobe functioning, was correlated with performance in the 2-back version of the n-back task, lending some support for the relationship between the PFC and inhibitory mechanisms.

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J.D. DAVIS, J.V. FILOTEO, J. FARGO, & R.P. KESNER. Object-Location Memory in Huntington's Disease: Examination of Encoding, Retention, and Recognition Processes.

On explicit verbal memory tasks, patients with Huntington's disease (HD) generally demonstrate severely impaired free recall, but relatively intact recognition memory and normal forgetting over a delay period. Given that memory performance disproportionately improves in HD when the retrieval demands are lessened, it has been suggested that the memory impairments associated with HD are primarily due to faulty retrieval processes. It is not clear, however, if impaired retrieval processes account for HD patients' memory deficits for other types of stimulus information. Hence, the present study examined explicit memory for visuospatial information in patients with HD. Thirteen patients with diagnosed HD and 13 age- and education-matched normal control (NC) participants were administered an object-location memory task. Participants were shown 16 objects located in different spatial locations in a grid. Free recall of both objects and locations was assessed over 5 learning trials and after a 15-min delay. Delayed recall was followed by recognition testing. HD patients showed impaired immediate and delayed free recall of objects and spatial locations, but retention and recognition discriminability were comparable to controls. HD patients did not show a differential pattern of impairment for objects relative to spatial locations. The observed memory profile is consistent with the verbal memory literature, lending further support to the notion that HD patients' memory deficit on explicit memory tasks is due to faulty retrieval rather than encoding or consolidation processes. This suggests that the striatum, damaged in HD, mediates the retrieval of newly learned information from memory.

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Poster Session 1/4:00–7:00 p.m.

ASSESSMENT

C.M. DIAZ-ASPER, D. J. SCHRETLEN, J.M. LILYESTROM, & G.D. PEARLSON. How Well Does IQ Predict Neuropsychological Test Performance in Normal Adults?

The strength and nature of the association between IQ and performance on other cognitive tests has both practical and conceptual importance for clinical neuropsychology. This study analyzed 28 measures derived from 17 cognitive tests, as a function of IQ test performance, in over 200 broadly representative, normal adults who participated in the Johns Hopkins Aging, Brain Imaging, and Cognition study. Subjects were grouped by their non-age-corrected scaled scores on a 7-subtest short form of the WAIS–R as having below average (BA), average (A), or above average (AA) intelligence. Because the groups differed in age, MANCOVA with age as the covariate was used to compare their other neuropsychological test performances. Planned comparisons revealed that BA subjects performed more poorly than A subjects on 26/28 cognitive measures, and that A subjects performed more poorly than AA subjects on 15/28 measures. Across the 28 measures, separate analyses revealed an average effect size

of .25 for BA–A comparisons and .20 for A–AA comparisons. Hierarchical multiple regression showed that IQ scores improved the model for 27/28 measures, after terms for age and education were entered. Linear, quadratic, and cubic functions described the relationship between IQ and cognitive performance about equally well for most measures, but quadratic and cubic functions predicted the proportion of "impaired" cognitive test performances better than a linear function. We conclude that IQ predicts concurrent cognitive test performance, but more so among persons of average IQ or less than among those with above average IQ.
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N. CRAIG, B. STEINBERG, L.A. BIELIAUSKAS, R. IVNIK, & G. SMITH. Age- and AMNART-Adjusted MOANS Norms, for the TMT, Stroop, and COWAT.
In a prior study (Steinberg, Bieliauskas, Ivnik, & Smith, abstract under review), we showed that older individuals' performances on the Trail-Making Test (TMT), Stroop Color-Word Test (Stroop), and MAE Controlled Oral Word Association Test (COWAT) were more strongly associated with their intelligence (Mayo age-adjusted WAIS–R FSIQ) than with their level of education. Based on those results, we created tables of age- and FSIQ-adjusted norms for each test. Because measures of sight-reading are often used to estimate premorbid cognitive functioning, we repeated our investigation in order to gauge the adequacy of Mayo age-adjusted American National Adult Reading Test (AMNART) scaled scores as an alternative to FSIQ scores. As predicted, AMNART scores were more strongly correlated with Mayo age-adjusted TMT, Stroop, and COWAT scaled scores [r = .187 to .314 (n = 354), r = .283 to .367 (n = 351), and r = .430 (n = 356), respectively] than was years of formal education (r = .174 to .242, r = .161 to .285, and r = .315, respectively). These AMNART correlations were less robust, however, than our previously reported FSIQ correlations (r = .368 to .495, r = .409 to .460, and r = .481, respectively). AMNART scores were associated with larger unique increases in TMT, Stroop, and COWAT scaled score variances in multiple regression models (.015 to .056; .051 to .066; and .097, respectively) than was education (.004 to .006; .000 to .008; and .008, respectively). Based on these results, we developed tables of age- and AMNART-adjusted norms for the TMT, Stroop, and COWAT.
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G.W. JONES, B.A. STEINBERG, L.A. BIELIAUSKAS, R. J. IVNIK, & G.E. SMITH. Age- and WRAT–R-Adjusted MOANS Norms for the BNT, MAE Token Test, and JLO.
In a previous study (Steinberg, Bieliauskas, Ivnik, & Smith, 2000, August), we demonstrated that older individuals' performances on the Boston Naming Test (BNT), MAE Token Test (Tokens), and Judgment of Line Orientation Test (JLO) were more closely related to their measured intelligence (Mayo age-adjusted WAIS–R FSIQ) than to their educational attainment; based on those results, we developed tables of age- and FSIQ-adjusted norms for each test. Because measures of sight-reading are frequently used to estimate overall premorbid functioning, we repeated our study in order to evaluate the adequacy of Mayo age-adjusted Wide Range Achievement Test–Revised (WRAT–R) Reading subtest scaled scores as an alternative to FSIQ scores. As expected, WRAT–R scores were more strongly correlated with Mayo age-adjusted BNT, Tokens, and JLO scaled scores [r = .455 (n = 291), .376 (n = 364), and .261 (n = 213), respectively] than was years of formal education (r = .348, .307, and .240, respectively). These WRAT–R correlations were weaker, however, than our previously reported FSIQ correlations (r = .608, .473, and .502, respectively). Although WRAT–R scores were associated with larger unique increments in BNT and Tokens scaled score variances in multiple regression models (.101 and .060, respectively) than was education (.014 and .013, respectively), WRAT–R and education produced comparable and negligible increments in JLO scaled score variance (.019 and .015, respectively). Based on these results, we constructed tables of age- and WRAT–R-adjusted norms for the BNT and Tokens.
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B.A. STEINBERG, L.A. BIELIAUSKAS, R. J. IVNIK, & G.E. SMITH. Age- and IQ-Adjusted MOANS Norms for the TMT, Stroop, and COWAT.
In three previous studies, we demonstrated that older individuals' performances on several popular neuropsychological tests (BNT, MAE Token Test, and JLO; WMS-R; AVLT and VSLT) were more closely related to their measured intelligence than to their educational attainment. Based on those results, we developed tables of age- and Mayo FSIQ-adjusted norms for each test. In the present investigation, we extended this line of research by examining data from MOANS participants (ages 56–99) who completed the Trail-Making Test (TMT; n = 354), the Stroop Color-Word Test (Stroop; n = 351), and/or the MAE Controlled Oral Word Association Test (COWAT; n = 777), in addition to the Wechsler Adult Intelligence Scale–Revised. FSIQ scores were more strongly correlated with Mayo age-adjusted TMT, Stroop, and COWAT scaled scores (r = .368 to .495; r = .409 to .460; and r = .481, respectively) than was years of formal education (r = .174 to .242; r = .161 to .285; and r = .367, respectively). Similarly, FSIQ scores were associated with larger unique increments in Mayo age-adjusted TMT, Stroop, and COWAT scaled score variances in multiple regression models (.103 to .181; .096 to .186; and .114, respectively) than was education (.000; .000 to .010; and .016, respectively). Based on these new results, we constructed tables of age- and Mayo FSIQ-adjusted norms for the TMT, Stroop, and COWAT.
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L. PATRICK, C. LECLERC, & M. PERUGINI. The Empirical Foundation of Neuropsychology-Based Recommendations in Geriatric Rehabilitation: A CQI Investigation of Clinical Practice.
Neuropsychological assessment has traditionally been used to aid in the diagnosis of diseases of the central nervous system. Within a rehabilitation context, however, neuropsychological assessment is playing an increasing role in delineating patients' cognitive strengths and weaknesses in order to address applied functional issues. The majority of related research in rehabilitation neuropsychology has been conducted with a young adult population, typically patients with acquired brain injuries. Relatively little is known empirically about the role of neuropsychological assessment for *geriatric* rehabilitation applications. Within a context of continuous quality improvement (CQI) in clinical practice, the present study investigated patterns of neuropsychology referrals on a 36-bed geriatric rehabilitation unit, with frail and comorbidly complex patients. The prevalence of referrals made to neuropsychology and the specific referral questions posed are outlined, subsequent to tabulation over a 12-month period. The study further examined the test selection utilized, the extent to which recommendations made by neuropsychologists covaried with test results, and the sensitivity of specific tests in addressing specific issues. Results revealed that referrals involved 1 or more of 3 issues to be addressed. The most frequent question was related to the patient's competency to live independently. Results revealed that varying recommendations regarding the level-of-care required were associated with significant differences on some test scores, but not others. Score patterns and recommendations made for each referral question are outlined and discussed.
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J.C. CEJUDO, D. BADENES, & GRUP DE NEUROPSICOLOGIA UFISS DE CATALUNYA. Verbal Fluency Test as a Global Cognitive Index.
Verbal fluency is used in order to evaluate dementia patients or cases of suspected dementia. This ability declines during the illness using the clas-

sical test of verbal fluency: animals in one minute (Ramier and Hécaen, 1977) the cognitive involution can be observed. *Aim:* The objective is to see if this task could assess cognitive worsening and if it could be used as a "global cognitive index." *Methods:* 300 patients were studied using verbal fluency in one minute (Peña Casanova, 1991), the Mini Mental State Examination (Folstein, 1975), and GDS 3, 4, 5, and 6 (Reisberg). *Results:* Inverse correlations were found for verbal fluency and GDS (Pearson $r = -0{,}62$) and MMSE (Pearson $r = -0{,}775$), both $p < .0001$). *Conclusions:* In order to facilitate clinical evaluation in cognitive illness, verbal fluency could be used to identify global cognitive functioning in cortical degenerative diseases, but it is less accurate than screening tests such as the MMSE.

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P. O'CONNELL. Is Creativity an Executive Function? Psychometric Properties of Tests of Creativity.

Throughout the middle 20th century, psychologist J.P. Guilford focused his work on operationally defining and assessing creativity. Operations Guilford considered necessary for creativity include fluency and flexibility of thought, specifically generation of diverse, often novel, responses, processes neuropsychologists consider executive functions. There is little information available about the psychometric properties of Guilford's creativity measures, although his tasks have been used in numerous neuropsychological studies. This study reports norms for 3 of Guilford's measures, Alternate Uses, Possible Jobs, and Making Objects, in addition to providing information about the relationship of these tasks with other neuropsychological instruments. Two hundred undergraduate students, 100 male, 100 female (M age = 21.47, range 17–50) were administered a 2-hr battery of tests as part of study of executive functions. All three Guilford measures evidenced a wide range of scores, resulting in adequate variability. Tests of skewness and kurtosis revealed no deviations from normality. Both Alternate Uses and Possible Jobs exhibited a significant, though modest, correlation with the Controlled Oral Word Association Test, a widely used measure of verbal fluency. Similarly, Making Objects demonstrated a significant, yet small, correlation with the Design Fluency task. The 3 Guilford tasks exhibited modest significant correlations with FSIQ. None of the 3 measures were correlated with either the Stroop or Wisconsin Card Sorting tests. These results suggest the Guilford measures may be of use in assessing fluency and flexibility.

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T. ROSS. The Reliability of Strategy Scores for the Ruff Figural Fluency Test.

This study examined the interrater and test-retest reliability of qualitative scoring indices for the Ruff Figural Fluency Test (RFFT) in a sample (n = 90) of healthy college undergraduates. In addition to rotational and enumerative strategies proposed by Ruff (1998), other supplemental indices were developed and examined. Seven raters scored protocols independently using guidelines proposed by Ruff (1988) and additional guidelines developed by the primary investigator. Intraclass correlation coefficients were excellent to good, ranging from $r_{icc} = .91$ for number of strategic clusters, to $r_{icc} = .79$ for mean cluster size. Coefficients of stability (n = 48; M interval = 7 weeks) for strategy scores were also acceptable (e.g., $r = .85$ for enumerative, $r = .77$ for rotational). This study is the first to examine the psychometric properties of these supplemental scores for the RFFT. Reliability coefficients obtained for traditional RFFT indices (e.g., novel designs, perseverations) were consistent with previous investigations (e.g., Ruff, 1988; Basso, Bornstein, & Lang, 1999). Also consistent with earlier findings, modest practice effects were observed on novel designs produced, but not for strategy scores. The implications of using RFFT strategy scores for assessing executive functions are discussed and considerations for future research are presented.

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M. BAGGETT, M. KELLY, D. CHRISTENSEN, G. GAHM, R. KANE, J. VIA, & V. INGRAM. Internet Enabled Neuropsychological Assessment.

Computerized automation of neuropsychological screening procedures may dramatically reduce the cost of neuropsychological assessment and allow for the development of unique applications. Computerized neuropsychological assessment permits highly accurate measurement of simple and complex reaction time. Near millisecond timing accuracy is possible when developers implement their tests correctly for different computer operating systems (Kane & Kay, 1992; 1997). This level of timing resolution has become increasingly important to neuropsychological research. The ability to assess cognitive status remotely through computerized neuropsychological assessment potentially allows for worldwide availability of neuropsychological assessment. In future clinical applications neuropsychological testing could be merged with telemedicine technology to allow for fairly comprehensive evaluations at some future date. The potential cost and manpower savings of reliable valid computer administered neuropsychological tests could potentially be enormous. In our current research studies we have internet enabled computerized neuropsychological measures that facilitate the conduction of research remotely with a centralized data collection system. Research data is encrypted, transmitted, and stored utilizing security features from our website via a secure server. These features include encryption, password security, and access controls. These neuropsychological tests reside within the password-protected web page on a secure server behind the firewall maintained by the Telemedicine Directorate at the Walter Reed Army Medical Center, Washington, DC. Two separate studies are currently being conducted at Fort Campbell, KY and Fort Rucker, AL from our research website at Walter Reed. This new research paradigm is discussed in the context of its future potential in neuropsychology.

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M. SHERER, S.R. MILLIS, & R.N. THOMPSON. Comparison of the WCST and the WCST–64 in Patients With Traumatic Brain Injuries.

The Wisconsin Card Sorting Test (WCST) has been shown to be a reliable, valid neuropsychological test with a variety of populations. The WCST is sensitive to diffuse brain injury and some studies have indicated that it is selectively sensitive to frontal injury. The WCST has been criticized for being too lengthy and stressful for some patients. The most impaired patients who are likely to have the poorest frustration tolerance must attempt all 128 trials. The WCST–64 has been proposed as an alternative to the WCST to address these problems. For the WCST–64, the subject must only complete the first 64 items from the original WCST. Similar scores can be calculated for the 2 tests. Comparative studies of the 2 tests have been limited. The present investigation studied the 2 tests in a sample of 77 patients with traumatic brain injury. Quartiles (25th, 50th, 75th percentiles) for age and years of education were 19.2, 24.7, 39.0 and 11, 12, 13, respectively. Injury severities were 44 severe, 22 moderate, 7 mild, and 4 unknown. WCST–64 scores were calculated by scoring the first 64 responses from the WCST. Intercorrelations between corresponding scores from the 2 tests ranged from 0.75 to 0.92 except for the Learning to Learn score with a correlation of 0.60. Regression equations indicated that WCST–64 scores account for $>$ 80% of the variance in key WCST scores such as Categories Completed and Perseverative Responses. These findings provide tentative support for clinical and research use of the WCST–64.

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A. PACHET, E. VAN HUSEN, & P. WASS. Validity of the RBANS with Acquired Brain Injury Patients.

The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) is a standardized screening instrument designed to assess cognitive functioning across a broad range of domains including immediate

and delayed memory, attention, language, and visuospatial/constructional abilities. The convergent and discriminant validity of the RBANS in comparison to established neuropsychological measures has yet to be investigated in post-acute adults with a moderate to severe acquired brain injury. A sample of 20 patients (M age = 43 ± 14; M education = 11.4 ± 2.4) referred for a neuropsychological evaluation from a post-acute inpatient brain injury rehabilitation program were administered the RBANS, followed by a broad neuropsychological test battery within 3 weeks. Participants had mean Glasgow Coma Scale scores of 5 (range = 3–9) at the time of their injury and were between 5 and 26 months post-injury (M = 12.3 ± 6.7). Pearson correlation coefficients were calculated between RBANS subtests and indices and selected standard neuropsychological measures. Significant relationships were observed between most RBANS subtests and indices and neuropsychological tests putatively assessing the same or similar cognitive domains. These results provide support for the convergent and discriminant validity of the RBANS in comparison to standardized neuropsychological measures. These data also provide further confirmation that the RBANS is a useful screening tool with patients who have had a moderate to severe acquired brain injury.
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S. LEMAY, E. CHENEVAL, & M.-A. BÉDARD. Test-Retest Reliability of Neuropsychological Tests in the Elderly.
Background: The test-retest reliability of many neuropsychological tests is not known. The aim of the present study is to evaluate the reliability of several neuropsychological tests sensitive to attention, memory, and executive functions. *Methods:* We tested 23 French Canadian adults (55–80 years) 3 times at intervals of 14 days. Cognitive assessment included: Parallel forms of the RAVLT, the 4-Color Stroop test, the Ruff 2 and 7 cancellation test, the Letter-Number Sequencing of the WAIS–III (LNseq), and the Tower of London (TOL). *Results:* Intraclass coefficients (ICC) indicated that the RAVLT showed good consistency for the total score of the 5 learning trials (.73), the immediate recall (.64), and the delayed recall (.71). Trial 6 (list B) and recognition had lower reliability (.49, .47). Derived scores (interference, learning, forgetting) also showed poor ICC (<.33). The 3 forms were equivalent. The Stroop test showed a good reliability for the completion time of the reading (.77) and naming (.74) conditions, but less so for interference (.48), and flexibility (.59) because of a significant learning effect (correlations remained between .60 and .80 for these 2 conditions). The Ruff test demonstrated good reliability for the speed (.83), efficiency (.72), and processing (.64) scores. The LNseq raw score showed a poor reliability (.48). In the TOL, the ICC were found to be poor for the number of moves (−.10 to .32), whereas initial thinking time showed a higher reliability (.40 to .78). *Conclusion:* Tests using chronometric or recall scores showed the greatest test-retest reliability.
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A. BAIRD, K. WISEMAN, & K. PODELL. A Short Form of the Independent Living Scales.
The Independent Living Scales (ILS) assess skills and knowledge thought to underlie successful independent functioning in older adults. Normative data in the test manual permit comparison of an individual with samples of older adults living independently, semidependently, or dependently. Earlier studies documented the strong relationship between the ILS and neuropsychological test scores. In our clinical setting, administration of the ILS takes 45 to 90 min. Because of pressures for efficiency in assessment and limits in the stamina of older adults, we explored the utility of the Money Management (MM) and Health and Safety (HS) T scores in predicting to the ILS summary score, the Full Scale Standard Score (FSSS). Of the 5 ILS subscales, MM and HS are the least redundant with other areas in our assessment. In our derivation sample of 85 adults from 61 to 91 years old, the R resulting from a stepwise regression analysis was .93, with the MM T entering first and producing an R of .86. In our cross-validation sample we computed an estimated ILS FSSS on 30 additional patients using the constant and weights from the derivation sample. The correlation between the estimated and actual ILS FSSS was .77. Results suggest that MM and HS scores provide a reasonably accurate estimate of the ILS FSSS.
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M. POPE, M. LAMAR, & A. ZONDERMAN. Using the Internet to Assess Insight and Its Cognitive Correlates in Normal Aging: Short-Term Reliability.
Despite the increasing number of studies that use the Internet to gather data, relatively little research has been done regarding the stability of web-based questionnaires over time. Even less is known about the stability of web-based questionnaires when used with older adults. We compared Time 1 (T1) responses from an Internet version of Broadbent's Cognitive Failures Questionnaire (CFQ) to Time 2 (T2) responses from the same Internet questionnaire administered approximately 1 month later (mean interval; 42.95 ± 15.15 days). Equal numbers of healthy elderly male and female participants from the Baltimore Longitudinal Study on Aging completed the CFQ (N = 20; age = 67.89 ± 8.9, education = 17.1 ± 2.1; Blessed Mental Status = 1.06 ± 1.39). Subjects also identified a collateral source (CS; N = 20) to fill out an informant adaptation of the Internet CFQ at T1 and T2 (mean interval: 41.35 ± 12.45 days). Total scores for subjects and CS were based on a 4-point Likert scale (max = 100). A discrepancy score (CS − subject scores) was calculated. Pearson's correlations of subject total scores, CS scores, and discrepancy scores for T1 versus T2 suggested good reliability (r = .88, r = .72, r = .80, respectively; p levels ≤ .0001). We found no significant differences in self-ratings over time, but there were significant differences in CS ratings over time (T1: M = 30.9 ± 15.33, T2: M = 26.3 ± 11.44, $t(19)$ = 2.75, p < .05). Both versions showed similar patterns of correlations to cognitive variables. The high short-term reliability supports the continued use of the Internet as a research tool both alone and in conjunction with neuropsychological testing and that older adults may be included in such research.
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M. LAMAR, M. POPE, & A. ZONDERMAN. Using the Internet to Assess Insight and Its Cognitive Correlates in Normal Aging: Alternate Forms Reliability.
Research comparing web-based data to paper/pencil data show increased variability and comparable internal consistency using the Internet. We compared Broadbent's Cognitive Failures Questionnaire (CFQ) to an identical Internet version as part of a study of insight into normal aging. Equal numbers of healthy elderly male and female Baltimore Longitudinal Study on Aging participants (N = 20) completed either the paper CFQ first and then the Internet (Paper 1st n = 10; age = 68.5 ± 8.1, education = 16.8 ± 2.1) or the Internet CFQ then the paper (Paper 2nd n = 10; age = 74.3 ± 7.9, education = 16.8 ± 2.3) plus cognitive testing. Groups did not differ on age, education, overall cognitive status (MMSE: Paper 1st = 29.0 ± 0.9, Paper 2nd = 28.9 ± 1.4), intellectual functioning, or depressive symptomatology. Subjects identified a collateral source (CS; N = 20) to fill out informant adaptations of CFQ versions. Total scores for subjects and CS were based on a 4-point Likert scale (max = 100). A discrepancy score (CS − subject scores) was calculated. Pearson's correlations of subject scores, CS scores, and discrepancy scores for Internet *versus* paper suggested high reliability (r = 0.75, r = 0.97, r = 0.90, respectively; p levels ≤.001). No significant differences were seen when totals were submitted to paired sample t tests. Both versions showed similar patterns of correlations to cognitive variables. The high alternate forms reliability supports the continued use of the Internet as a research tool alone and in conjunction with neuropsychological testing. Despite anecdotal impressions that younger participants may be more computer savvy than older participants,

results suggest that older adults with less computer exposure may be included in web-based research.
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P. TAYLOR-COOKE & P. FASTENAU. Effects of Test Order & Modality on Attention in Child Epilepsy: Study II.
Rationale: Studies suggest that neurological insult and fatigue affect sustained attention, especially for longer, auditory tasks. A pilot study by Taylor-Cooke and Fastenau (2001) confirmed effects of condition severity and test order in a sample of children with epilepsy, but the test order effect was observed only in the visual (not auditory) modality. Those results were potentially confounded because attention-intensive tests were given back-to-back (which is not characteristic in neuropsychological batteries) and because the auditory measure took much longer than the visual measure (thus, lengthening the testing time preceding the visual measure). The present study controlled for those limitations. *Method:* 54 children with chronic epilepsy participated (M age = 12.9, SD = 1.9; 61% girls). By random assignment, 25 completed a 10-min version of Conner's CPT first. Then, each participant completed 7 Woodcock-Johnson Revised subtests, followed by the other attention test. Percent omissions were analyzed using a 2 × 2 (Order × Modality) mixed ANOVA. *Results/Discussion:* There was a modality effect (auditory worse than visual), $F(1,52) = 98.93$, $p < .001$, but no order effect, $F(1,52) = 0.12$, $p > .05$ and no interaction, $F(1,52) = 0.11$, $p > .05$. This confirms the original hypothesis that auditory attention is more vulnerable to fatigue. Taken together with the pilot results, these findings suggest that ordering of attention tests in a neuropsychological battery affects scores only when attention-intensive tests are given in close proximity to one another in the battery.
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P.S. FASTENAU, W.T. HANKINS, C.S. McGINNIS, T. MOY, & M. RICHARD. Effects of Alternate Forms on Retest Effects in Clinical Testing.
Objective: In this study, we examined the extent to which alternate forms reduce retest effects. *Method:* Participants were 45 healthy adults (76% female, 87% right-handed, 89% Caucasian/Non-Hispanic) ranging in age from 18 to 43 (M = 24.4, SD = 6.6). Education ranged from 12 to 20 years (M = 13.5, SD = 1.7). WRAT–3 Reading standard scores ranged from 86 to 117 (M = 104.0, SD = 8.6). Participants completed a 50-minute battery (Time 1) of 7 tests in the following order: Rey Auditory-Verbal Learning Test (AVLT); Brief Visual Memory Test–Revised (BVMT–R); WAIS–III Digit Span (DSp), Digit Symbol (DSy), and Letter-Number Sequencing (LNS); Trail Making Test (TMT); and Paced Auditory Serial Addition Test (PASAT). After a 10-minute break, participants repeated the battery (Time 2). Alternate forms were carefully constructed for each test (Fastenau et al., 2001). By random assignment, participants completed either the same form at both times or different forms at each time (order was counterbalanced across groups). *Results:* A 2 × 2 (Form × Time) mixed ANOVA showed a main effect for Time (better at Time 2) on all measures, $F > 3.10$, $p < .05$. An interaction on AVLT ($F = 24.2$, $p < .0005$) and BVMT–R ($F = 25.2$, $p < .0005$) showed the retest effect in the same-form group only; on all nonmemory measures, there was no interaction, $p > .10$. There was no effect for form, $p > .10$. *Conclusion:* Retest effects on memory and learning tests can be corrected by use of equivalent alternate forms. Retest effects on nonmemory tests may require multiple practice trials to attenuate the retest effect.
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S.E. WOODROME & P.S. FASTENAU. Test-Retest Reliability of the Extended Complex Figure Test (Motor Independent).
Rationale: The Extended Complex Figure Test (ECFT) provides recognition and matching components to the Rey-Osterrieth Complex Figure Test. A new variation, ECFT–Motor Independent version (ECFT–MI), removes the fine motor requirements of the ECFT. Not yet established is the ability of ECFT–MI Recognition and Matching to provide stable results over time. Therefore, test-retest reliabilities of the ECFT–MI were examined. *Method:* 34 healthy adults ages 21–60 (M = 36.2, SD = 13.0); the sample was 82% female, 85% Caucasian, and 88% right handed. Education ranged from 10 to 18 years (M = 14.6, SD = 1.6). Participants were tested at 2 times (T1, T2) 1 week apart. The ECFT–MI was given as part of a battery taking 2 to $2\frac{1}{2}$ hours to complete. Each component of the ECFT–MI consists of 5 subscales designated as Global, Left Detail, Right Detail, Detail, and Total. *Results:* For Recognition, Pearson product-moment correlations between T1 and T2 were .82 ($p < .0005$) for the Total Scale and .48 to .75 for the 4 subscales ($p \leq .004$). For Matching, test-retest correlations ranged from .13 to .24 ($p > .10$). *Discussion:* The Recognition element of the ECFT–MI appears to have strong test-retest reliability. Matching does not appear to be as strong, limited by a restriction of range because all participants scored at or near the ceiling on all Matching subscales. The effectiveness of the Matching component of the ECFT–MI may be best reevaluated with a neurological population that shows the fuller range of scores.
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A.Y. ZHELTUKHIN, J.L. WOODARD, & K. SHANNON. Making Digit Symbol Substitution Test Memory Oriented.
Two groups of young health adults [Group 1: N = 38, M age = 19.8 (SD = 1.57), M years of education - 14.2 (SD = 1.04); Group 2: N = 39, M age = 19.9 (SD = 2.14), M years of education = 14.3 (SD = 0.95)] performed a computerized version of the Digit Symbol Substitution (DSS), which closely emulated the conventional pencil-and-paper format. For Group 1, the keys were located at the top of the form. For Group 2, the keys were presented on a computer screen, making the look-up more time-consuming. For each unit, we computed processing speed (length of the strokes divided by the sum of the time spent on drawing a figure in the unit and the time of the preceding pause), and averages of the speed measure for the unique unit types. The key locations affected the look-up strategies: Group 2 relied more on memorizing the symbol-number pairings, processing more neighboring units without lookup than Group 1 [$F(1,75) = 43.9$, $p < .01$]. Group 1 performed significantly faster than Group 2 [$F(1,75) = 27.8$, $p < .01$], completing significantly more units (85), than Group 2 (74) [$F(1,75) = 13.6$, $p < .01$]. Both groups processed figures with unique shapes faster than figures with common features. The loss of processing speed during the completion of units with similar features displayed a significant negative correlation with scores on the Category Fluency (CF) test, which was higher for Group 2 ($r_1 = -0.31$, $p < 0.05$; $r_2 = -0.41$, $p < .05$).
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A. ZHELTUKHIN, J. WOODARD, & K. SHANNON. Processing Differences on the Computerized Digit-Symbol and Symbol-Digit Coding.
A group of healthy adults [N = 39, M age = 19.9 (SD = 2.14), M years of education = 14.3 (SD = 0.95)] was administered a computerized version of Digit Symbol Coding (DSC) and Symbol-Digit Coding (SDC) tests. For each test unit and unique unit type, we computed processing speed (length of the strokes divided by the sum of the time spent on drawing a target in the unit and the time of the preceding pause). The keys were presented on a computer screen, making the look-up more time-consuming. Unlike DSC, where the keys are numbers in ascending order, locating a key (symbol) in SDC might require more scanning. We expected that this difference would prompt the participants to rely on memorizing the symbol-number pairings more during SDC, which would result in processing more neighboring units without consulting the keys and faster processing speed. The participants displayed a significantly faster processing speed on SDC [$F(1,74) = 30.6$, $p < .01$] and a nonsignificant trend to complete more neighboring units without look-up (SDC = 4.2, DSC = 3.5). The mean

number of units completed was not significantly different for the 2 tests (DSC = 74; SDC = 72), although the total length of strokes was significantly higher for SDC. On both tests, the participants processed symbols with unique shapes significantly faster than symbols with common features. On SDC, however, the participants were able to memorize at least 1 symbol from the less discriminative group, which resulted in a higher processing speed for that symbol-number pairing.
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E. DROWN & J. ALLEN. Clinical Utility of the COGNISTAT for an Outpatient, Dual Diagnosis Program.
The Neurobehavioral Cognitive Status Examination (COGNISTAT) is a brief measure designed to assess multiple domains of cognitive functioning including: level of consciousness, orientation, attention, language, constructional ability, memory, mental calculations, and reasoning. The clinical utility of this measure has been examined across varied treatment populations with inconsistent results (Nabors et al., 1997; Fals-Stewart, 1997; Harrell & Benoche, 1999). Given the variable performance, the heuristic value of this measure being utilized in an initial screen for a clinical population of dually diagnosed was questioned. The present study examines the COGNISTAT scores of subjects approved for admission into a standard outpatient chemical dependency treatment program during a 6-month period. The sample was comprised of individuals meeting criteria for being dually diagnosed with a neurological disorder and substance abuse difficulty (n = 29; 26 males, 3 females; M age = 32.3 ± 7.6). Indicators of treatment outcome were identified: participation rate in an introductory 10-week psychoeducational group, results of random urine drug screens and subjective facilitator report of client participation. Along with descriptive information on the sample, correlation and regression analysis was used in an attempt to identify the general relationship between the various cognitive domains measured by the COGNISTAT and the outcome markers. Obtained results reflected several weak correlations, but none reaching statistical significance ($p < .05$). Implications for future research are addressed within the context of adding to the growing body of research addressing the ecological validity of this measure.
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N. VISCOVICH, J.C. BOROD, A. BRICKMAN, H. PIHAN, S. PEERY, & M. TABERT. Computerized Indices of Affective Prosody in Normal Adults Using a Neutral Control.
Prosodic expression is a salient channel of emotional communication and can be assessed through computerized acoustical analysis. Fundamental frequency (F_0) is the most commonly studied measure (Banse & Scherer, 1996) and potentially the best index of perceived pitch and emotional intensity. From a neuropsychological perspective, affective prosody is key in evaluating emotional processing deficits in neurological and psychiatric disorders. Here, we examined parameters that can influence acoustical measurement—gender and emotion type. A unique feature was the use of a neutral expression as a baseline nonemotional control. Subjects were 19 healthy men and women, matched for age (M = 29.2 years), education (M = 15.6 years), and occupation [M = 6.7 (9-point scale)]. Subjects posed neutral-content sentences with happy, sad, and neutral intonation, using procedures from The New York Emotion Battery (Borod, Welkowitz, & Obler, 1992). The Computerized Speech Lab Program (Kay Elemetrics, 1994) extracted F_0 mean, median, and standard deviation from each sentence. For central tendency, women produced sentences with greater ($p < .005$) F_0 than did men, and happy sentences were produced with greater ($p < .001$) F_0 than were sad and neutral sentences. For variability, men produced sentences with greater ($p < .001$) F_0 than did women, and happy sentences were produced with greater ($p < .001$) F_0 than were sad and neutral sentences. When performance on the neutrally-intoned sentence was statistically controlled, central tendency differences generally remained, and variability differences remained for gender but not for emotion. Findings are discussed in terms of induction-procedure methodology and implications for rehabilitation of social skills and interpersonal relations in clinical populations.
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B.K. CHRISTENSEN, J.M. CANTOR, C.P. MILLIKIN, & R.M. BLANCHARD. Factor Analysis of Two Brief Memory Tests: Preliminary Evidence for Modality-Specific Measurement.
Memory assessment is a fundamental aspect of the neuropsychological evaluation. However, 2 problematic features limit the utility of most conventional memory measures. First, the administration of many instruments is time-intensive and precludes brief assessment of memory function. Second, although many measures include estimates of verbal/auditory and visual memory performance, factor analytic studies have often failed to uncover latent dimensions that readily correspond to domain-specific memory constructs (i.e., verbal/auditory or visual memory). This study examined the dimensional structure of 2 brief memory tests: the Hopkins Verbal Learning Test (HVLT) and the Brief Visuospatial Memory Test–Revised (BVMT–R). The sample consisted of 314 psychiatric patients with diagnoses of major depression (19%), schizophrenia/schizoaffective disorder (13%), sexual paraphilia (57%), or anger control difficulties (11%). Three core indices from each measure (total items recalled over 3 learning trials, delayed free-recall, delayed recognition discriminability) were subjected to a principal components analysis with varimax rotation. Two factors with eigenvalues greater than 1 were extracted. Collectively these factors accounted for 79% of the matrix variance. Using a cutoff of .45, factor loadings indicated that the first factor was defined exclusively by HVLT indices (factor loading range = .84–.89) while the second factor was defined exclusively by BVMT–R indices (factor loading range = .76–.84). These results strongly support interpreting these scales as measuring domain-specific aspects of memory when used to assess psychiatric patients.
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L. DREER, T. CHINNERY, & R. SKEEL. What Is Matrix Reasoning of the WAIS–III Really Measuring?
Although Matrix Reasoning has been found to load highly on the Perceptual Organization of the Wechsler Adult Intelligence Scale–Third Edition (WAIS–III), it has also been suggested to be a measure of constructs such as abstract reasoning or executive functioning (Dugbarty et al., 1999). In order to discern whether Matrix Reasoning is more of a perceptual organizational measure or a classical executive functioning test, a factor analysis was conducted with Matrix Reasoning and other perceptual organization measures of the WAIS–III (Block Design and Picture Completion), and measures commonly associated with executive functioning, the Booklet Category Test (BCT) and Trails B (Choca et al., 1997). The sample included 139 participants with heterogeneous cognitive dysfunction screened for confounding factors such as low effort or psychiatric history. Based on evidence that the BCT measures multiple constructs (Kelly, Kundert, & Dean, 1992), BCT data were entered using individual subtest scores (excluding subtests 1 and 2), leading to 9 total variables in the model. Maximum-likelihood analysis with oblique rotation was used to evaluate the data. A 3-factor solution best accounted for the data and included: Factor 1, Perceptual Organization (23.0% of the variance; Picture Completion, Block Design, Matrix Reasoning, Trails B); Factor 2, Proportional Reasoning (19.2% of the variance; BCT subtests 5 and 6); and Factor 3, Spatial Positioning (15.4% of the variance; BCT subtests 3, 4, & 7). Results suggest Matrix Reasoning is a measure of perceptual organization that is distinct from abstract reasoning as measured by the BCT. Clinical implications are discussed.
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G.M. REGER, J.S. McGEE, J.G. BUCKWALTER, M. THIEBEAUX, & A.A. RIZZO. Scoring a 3D Virtual Environment Rod-and-Frame Test: The Reliability and Validity of 4 Scoring Methods.
This study evaluated reliability and concurrent validity of a 3D virtual environment rod-and-frame test (VERF) according to 4 different scoring methods previously utilized with 2D rod-and-frame tests. Several 2D rod-and-frame scoring methods have been found to be reliable, with the most conventional being the absolute deviation of rod placement from true vertical. In this study, 30 nonimpaired older adults (15 men, 15 women) aged 64 to 86 ($M = 73.6$) sat in an upright chair in front of a $5' \times 7'$ rear-projection screen. A white rod surrounded by a yellow frame appeared on the screen, seemingly afloat in space. Participants manipulated the rod in 3D across 10 trials with varying orientations of rod to frame. When they believed that they had positioned the rod vertically to the floor while ignoring the frame, they pressed a button. Results suggested that the conventional 2D scoring method of absolute deviation from vertical was the most reliable method to utilize when scoring VERF (alpha = .79). Also, there were higher correlations between this method and traditional neuropsychological measures of spatial ability. Another scoring method, which focused on errors away from the frame, demonstrated poor reliability, raising special issues for using this method when scoring older adult responses to VERF. With the utilization of a reliable and valid scoring method, the advantages of 3D VEs, such as VERF, may enhance the measurement of field dependence. Specifically, with the addition of discrete computer scoring, reliability and ecological validity may be improved.
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J.M. LOVE, N. VITONE, E. SHERWIN, & K.W. GREVE. Comparability of the Standard WCST and WCST–64 in Traumatic Brain Injury.
The purpose of the present study was to examine the comparability of the standard Wisconsin Card Sorting Test (WCST) with the newly published 64 card abbreviated version (WCST–64) in a traumatic brain injured (TBI) sample. Participants were 60 survivors of severe TBI who were at least one year (median = 11.4 years) post injury and living at a large residential brain injury facility. The WCST was administered by standard procedure and then scored using commercially available software for both the standard and 64 card versions. Alternate form agreement using nonparametric correlation coefficients [Spearman Rho: Total Errors (TE), Perseverative Responses (PR), Perseverative Errors (PE), Non-Perseverative Errors (NPE), and Percent Conceptual Level Responses (CLR); Kendall tau-c: Categories Completed (CAT), Failure to Maintain Set (FMS), and Learning to Learn (LL)] was high ranging from .95 to .57. FMS displayed the least agreement and CLR the greatest. Also, all of the scores with age and education norms were examined for level of impairment agreement (i.e., normal, mild, moderate, severe). Actual impairment levels were quite stable with 77 to 100 percent of the subjects changing 1 level or less, depending on the score. LL displayed the least impairment agreement with over 50% changing at least 1 impairment level. These results support the WCST–64 as a valid alternative to the standard administration of the WCST.
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J.M. LOVE, A. BRENNAN, E. SHERWIN, & K.W. GREVE. Temporal Stability of the Wisconsin Card Sorting Test in a Traumatic Brain Injury Sample.
The Wisconsin Card Sorting Test (WCST) is often repeatedly administered in both clinical and research settings. However, only 2 published studies of its temporal stability exist. The first study used normal elderly persons with minimal deficits, and the second used obstructive sleep apnea patients, a group with unstable cognitive deficits. The aim of the present study was to investigate the WCST's temporal stability in a clinical population with documented brain pathology, stable cognitive deficits, and for whom repeated testing is common: severe traumatic brain injury (TBI). Participants were 34 persons at least one year (median = 11.3 years) post severe TBI living at a large residential brain injury rehabilitation facility. The WCST was administered by standard procedure on 2 occasions (median test–retest interval = 53.7 weeks). Nine scores [Total Errors (TE), Perseverative Responses (PR), Perseverative Errors (PE), Non-Perseverative Errors (NPE), Percent Conceptual Level Responses (%CLR), Categories Completed (CAT), Trials to First Category (T1C), Failure-to-Maintain Set (FMS), and Learning to Learn (LL)] were examined. Stability coefficients based on raw scores ranged from .42 to .80 for the first 5 scores, with NPE least stable. Coefficients were substantially lower for the remaining 4. Nonetheless, actual impairment levels were quite stable, with 72% to 94% of the subjects changing one level or less depending on the score. FMS was the least stable with 50% of participants changing at least 1 impairment level. Confidence intervals for significant change are provided for clinical use. The clinical and theoretical relevance of these results is discussed.
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K.W. GREVE, T.R. STICKLE, J.M. LOVE, M.T. HEINLY, A. BRENNAN, N. VITONE, K.J. BIANCHINI, & M.S. STANFORD. Confirmatory Factor Analysis of the Wisconsin Card Sorting Test.
The Wisconsin Card Sorting Test (WCST) has been the subject of considerable factor analytic research over the past 10 years, yet debate continues as to the exact number and composition of its underlying factors. The present study used confirmatory factor analysis (CFA) to evaluate 1, 2, and 3 factor solutions which have been reported in the literature. Subjects were a mixed sample of 1221 neurological ($n = 623$) and psychiatric ($n = 225$) patients, and nonclinical control subjects ($n = 373$). The WCST was administered and scored in standard fashion. Seven scores [Total Correct (TC), Perseverative Responses (PR), Perseverative Errors (PE), Non-Perseverative Errors (NPE), Percent Conceptual Level Responses (%CLR), Categories Completed (CAT), Failure-to-Maintain-Set (FMS)] were submitted for CFA. The 1-factor model used all 7 scores as indicators. In the 2-factor model, the indicators were (1) PE, PR, CLR, CAT, & TC; and, (2) CLR, CAT, TC, NPE, & FMS. In the 3-factor model, indicators were, (1) PE, PR, CLR, CAT, & TC; (2) CLR, CAT, TC, NPE; and (3) TC & FMS. Results of the analyses were mixed with a 1-factor model providing poor fit, and the 2- and 3-factor models producing fit indices just outside the lower range of those considered adequate. The lack of fit may be due to several factors including: (1) significant overlap among variables; (2) different best-fit models for different clinical subgroups; (3) error due to between-subjects differences in test length; and (4) too few indicators for some latent variables. Clinical relevance and future directions are discussed.
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T.D. PARSONS, A.R. RIZZO, & J.G. BUCKWALTER. Comparison of Back Propagation and Regression for Estimation of Processing Speed.
Conventional methods for prediction in neuropsychological research make use of the General Linear Model's (GLM) statistical regression. Although regression analysis subsumes univariate analyses and can provide researchers with a robust understanding of their data, the regression model tends to be one of the most abused statistical methods (Darlington, 1968). While the normality assumption is justifiable in many situations, independence of error variance can pose a significant amount of restriction. An alternative is to use Artificial Neural Networks (ANNs) because they are able to learn from a set of data without the need for a full specification of the decision model, and are more robust in the presence of correlated error (Bishop, 1995). In this research the aim was to compare the applicability of a back propagated ANN for use in a common neuropsychological problem with that of conventional regression analysis. Thirty individuals between the ages of 64 and 86 (M age = 73.6,; M years education = 15.4; % women = 50) participated in a study designed to validate a new test of spatial ability administered in virtual reality. As part of this project a standard neuropsychological battery was administered. Results from the multiple regression model ($R^2 = .21$, $p < .28$; Standard Error = 18.01) were compared with those of a back propagated ANN ($R^2 = .39$, $p < .02$;

Standard Error = 13.07). This 18% increase in prediction of a common neuropsychological problem demonstrated that an ANN can outperform a regression.
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L.M. RILLING, G. TREMONT, A. PODOLANCZUK, & R.A. STERN. The Validity and Classification Accuracy of the Wisconsin Card Sorting Test–64.

The Wisconsin Card Sorting Test (WCST) has become one of the most widely used measures of executive functioning in both clinical and research settings. However, administration can often be lengthy and frustrating, especially for individuals with cognitive impairment. In response to these concerns, several shortened versions of the WCST have been described, though their clinical utility has been limited by a lack of normative data. Given the recent publication of the WCST–64 professional manual, the use of this abbreviated version will likely increase in clinical practice. The present study was designed to investigate the validity and clinical utility of the WCST–64 within a clinical population by comparing the raw scores, standard scores, and clinical classifications derived from the WCST–64 to the WCST. Using archival data from 196 patients referred for neuropsychological evaluation, protocols were scored using both the 64- and 128-card versions. Pearson and Kendall's Tau correlations between WCST–64 and WCST Perseverative Responses *T*-scores were .73 and .64, respectively. However, only 42.3% agreement was revealed between clinical classification categories for the WCST–64 and the WCST, suggesting that a significant number of patients were misclassified by the WCST–64. Additional analyses suggested that the WCST–64 tended to produce more false positives for patients with poor Learning-to-Learn scores and failed to identify patients with significant loss of set, as compared to the full WCST. These findings suggested that, although the WCST–64 demonstrated adequate validity within a broad clinical population, its clinical utility may be limited to patients with less executive dysfunction.
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L. RIEMENSCHNEIDER, B. ROPER, M. ROBERTS, K. MARSHMAN, T. BENNETT, & R. LINDO. Enhanced Memory Screening: Preliminary Comparison of the DWRT to the RBANS.

The Delayed Word Recall Test (DWRT; Knopman and Ryberg, 1989) is a verbal memory test specifically designed to capture the amnestic impairment characteristic of Alzheimer's dementia (AD). Although the DWRT has been shown to be highly effective in discriminating persons with mild AD from healthy elderly controls, it has not been compared to more traditional memory measures, such as word-list learning or paragraph memory. In a series of 56 patients referred for neuropsychological assessment, the DWRT was compared to the memory components of the RBANS. DWRT scores were only modestly correlated with the RBANS Delayed Memory Index (DMI: $r = .34$, $p < .01$), suggesting a weaker relationship than was found between the RBANS DMI and the WMS–R Delayed Recall Index ($r = .49$; Randolph, 1998). DWRT performance was unrelated to RBANS age-corrected List Learning or List Recall but moderately correlated with Story Memory ($r = .35$, $p < .01$) and Story Recall ($r = .42$, $p < .001$). The RBANS classified more persons as impaired than did the DWRT (Wilcoxon rank-sum test, $Z = 2.99$, $p < .01$). A possible interpretation is that the RBANS DMI is more sensitive than the DWRT in classifying memory impairment. However, in light of the DWRT's design as a measure of the amnestic impairment commonly found in AD, it is possible that the DWRT measures a more specific type of verbal memory impairment, potentially offering better characterization of patients' memory performance than might be obtained by using traditional measures alone.
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M. HUSKEY & S. HALL. A Comparison of Two Malingering Tests: The TOMM and the PDRT.

The Test of Memory Malingering (TOMM) and the Portland Digit Recognition Test (PDRT) are 2-alternative, forced-choice tests that have been shown to be effective at correctly classifying patients with actual cognitive deficits and individuals who are malingering cognitive impairment. The purpose of this study was twofold: (a) compare the ability of the TOMM and the PDRT to correctly classify subjects simulating cognitive impairment and controls, and (b) examine the effects of different levels of coaching provided to simulators. Subjects were 97 college students each randomly assigned to participate as a control subject, or a simulator with no coaching, minimal coaching, or detailed instruction about head injury. ANOVA indicated that control subjects obtained significantly higher scores than all 3 of the simulator groups for both the TOMM and the PDRT. *Post-hoc* analysis revealed that the 3 simulator groups did not differ from one another. Therefore, the different levels of coaching did not affect the simulators' performance. Using established cutoff scores, both tests correctly classified all control subjects. However, the TOMM correctly classified a substantially higher percentage of subjects in all 3 simulator groups. These findings suggest that the TOMM may have an advantage over the PDRT in classifying individuals malingering cognitive deficits, regardless of level of coaching.
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R. SKEEL, D. SITZER, J. WELLS, T. FOGAL, & N. CHRISTIANSEN. Differences in Memory Impairment Classification Rates Based on Alternative Interpretation Methodologies.

The WAIS–III/WMS–III Technical Manual (The Psychological Corporation, 1997) provides 2 methods for examining discrepant scores between intellectual functioning and memory for significance, the Simple Difference method and the regression-based Predicted Difference method. It is unknown how these methods may be affected in a clinical sample, as neither method compensates for premorbid functioning. An alternative method analyzes discrepancies between estimated premorbid IQ and obtained memory scores based on regression techniques for reliable differences. It was hypothesized that a method using premorbid estimation would classify significantly more individuals as impaired than other methods. WAIS–III, WMS–III, and WRAT–III (used for premorbid estimate) scores for a group of 39 males and 48 females with a history of TBI screened for confounds of learning disability, language disorder, and low effort (mean education = 12.9) were examined using the 3 identified methods. Overall, the Predicted Difference method tended to classify the fewest individuals as impaired based on statistical significance (11% to 16% classified as impaired), while the regression-based Premorbid method tended to classify the fewest individuals as impaired based on clinical significance (4% to 8% classified as impaired). The only comparison between methods to reach statistical significance was the Predicted Difference method classifying subjects as impaired at a statistically significant higher rate than other methods for Auditory Delayed memory index (Cochran's $Q = 7.00$, $p < .05$). This study suggests that a combination of estimates of premorbid functioning and regression-based predicted scores is appropriate for interpreting memory scores depending on specific case characteristics. Clinical implications are discussed.
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D. DRANE, R. YUSPEH, L. KLINGLER, J. HUTHWAITE, & M. MRAZIK. Introduction of a Total Composite Score for the Cognistat (NCSE).

The Cognistat (NCSE) is a mental status examination used to screen for dementia and other cognitive disorders. The Cognistat has been criticized for lacking a total composite score, and having a high frequency of false negative errors resulting from the use of a "screen and metric" format for item presentation. The present study introduces a total composite score derived by administering the full metric from each subscale, and summing the obtained subscale scores. One hundred forty-five participants without

history of psychiatric or neurologic disturbance were included in this study. Participants ranged in age from 20 to 96 years ($M = 63.90$, $SD = 19.56$), and ranged in education from 7 to 20 years ($M = 14.21$, $SD = 2.51$). The mean Cognistat composite score was 74.48 ($SD = 4.62$), out of 82 possible points. Correlational analyses demonstrated a significant inverse relationship between age and Cognistat composite score ($r = -.39$, $p < .0001$), accounting for 15% of the variance in this score. A more modest yet significant relationship was observed between the composite score and education ($r = .26$, $p < .001$). Participants were assigned to 3 age groups (i.e., 20–50 years, 51–74 years, and ≥ 75 years), and compared on Cognistat total score. Univariate ANOVA revealed the ≥ 75 year-old age group to have a significantly lower mean Cognistat total score than the other 2 age groups, which did not significantly differ from one another. Normative scores for the Cognistat composite and subscale scores are presented by age, and recommendations for research utilizing the Cognistat total score are discussed.

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P. MARSHALL, J. HUBBARD, C. O'HARA, & P. STEINBERG. An Empirical Evaluation of the Relationships Among Purported Measures of Working Memory, Attention, and Cognitive Processing Speed.
This study evaluated the relationships among tests of attention, speed of cognitive processing, and several purported measures of working memory: Digit Span Forward and Backward, Conners Continuous Performance Test, Hick Paradigm Choice Reaction Time Test, Sternberg Memory Scanning Task, Buschke Selective Reminding Test, Paced Auditory Serial Addition Task (PASAT), and Salthouse Listening Span Task (SLST). There is general agreement that working memory involves at least 2 distinct capacities, one structural and one operational: (a) the number of distinct information units that can be remembered at any given time and (b) the number and complexity of cognitive processing operations that can be performed while still preserving the products of earlier operations. There is also evidence that speed of cognitive processing is a major determinant of working memory function. Principal components analysis of 53 normal subjects' test results revealed 4 components interpreted as attention, cognitive processing speed, working memory, and impulsivity. This analysis also indicated that performance on the Digit Span Backward and PASAT tests is determined primarily by the structural (verbal attention capacity) component of working memory. In contrast, performance on the SLST is determined by this structural component as well as the operational component of the working memory construct. Correlations and simultaneous entry multiple linear regression suggest that attention span makes a much more significant contribution than cognitive processing speed to performance when a working memory test involves a more demanding parallel task load on temporary storage, as well as cognitive processing of information in short term store.

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R.S. WAXMAN & B.P. ROUKE. Diagnostic Utility, Construct Dimensions, and Developmental Sensitivity of the Children's Word-Finding Test–Revised.
The clinical utility and construct dimensions of the Children's Word-Finding Test–Revised (CWFT–R) were examined within a developmental framework. Participants were 361 diagnostically heterogeneous children aged 6 through 8 years inclusive who were referred for neuropsychological assessment and who were administered a comprehensive neuropsychological test battery. CWFT–R performance of the 7- and 8-year-old clinic-referred children ($n = 40$) was compared to a sample of normal children; this revealed significant differences in that the normal children consistently performed at a superior level. Comparisons between the performance of the 6-, 7-, and 8-year-old clinic-referred children also revealed differences such that the older groups outperformed their younger counterparts. Using partial correlations to control for age, data of the 361 clinic-referred children were subjected to Principal Components Analysis, generating a 3-factor solution accounting for 55% of the total variance. Factor analytic solutions derived with and without age as a covariate generated significantly different factor structures. Correlations between the CWFT–R and measures of verbal ability, phonological processing, nonverbal problem-solving, and visual-spatial skills were examined. CWFT–R correlated with each of the measures included in the current study, but shared the most variance in common with measures of verbal ability and general word knowledge. Although consistent with previous findings, CWFT–R performance for the 6- and 8-year-old groups demonstrated the greatest association with WISC/WISC–R VIQ followed by FSIQ, and PIQ, respectively, it was also clear that the CWFT–R has considerable diagnostic utility because of its sensitivity to verbal and nonverbal abilities beyond those measured by the WISC/WISC–R.

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M. WEBER & R. J. McCAFFREY. Correlations Between IQ and General Neuropsychological Deficit Scores in a Brain-Injured Sample.
There is debate in the literature about the relationship between measures of general intelligence and the presence or absence of brain damage. While intuitively, it would seem that measures of intelligence such as the Wechsler Scales would be negatively impacted by brain damage, others have argued that tests of brain functioning, such as the Halstead-Reitan Neuropsychological Battery (HRNB) measure different capacities. The purpose of this investigation was to answer this question empirically. A group of outpatients undergoing a neuropsychological evaluation for possible brain impairment ($N = 107$) were administered the HRNB as part of a standard battery. Using traditional General Neuropsychological Deficit Scale (GNDS) cut-off scores (Reitan & Wolfson, 1993), the patients were divided into 3 groups; normal, mild, or moderate neuropsychological impairment. We then examined the relationship between GNDS and Full Scale IQ based on the Wechsler Adult Intelligence Scale–Revised (WAIS–R). In all cases, there were no statistically significant correlations between NDS and IQ. One-way ANOVA revealed significant differences in mean FSIQ between all of the groups, with the normal subjects having the highest and the moderately impaired subjects have the lowest mean IQ. Implications of these findings for clinical practice, as well as the effects of additional demographic information on neuropsychological performance, will be discussed.

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B.A. HAYMAN-ABELLO & B.P. ROURKE. An Examination of the Construct Dimensions of the Underlining Test.
The Underling Test (UT) is a set of 14 speeded cancellation tasks (subtests), each varying in content such that subsequent subtests become more complex and verbally based. Originally developed to measure speed of visual processing, the UT (or certain subtests) has since been used to assess a variety of other cognitive abilities, including visual discrimination, focused attention, psychomotor speed, executive functioning, and as a predictor of reading disabilities in children. In the present study we examined the underlying factor structure of the UT using an exploratory factor analysis technique in a heterogeneous sample of 848 clinic-referred children (primarily with learning disabilities) aged 9–14 years. Subtest scores were converted to *T*-scores using age-referenced normative data and submitted to a principal components analysis with an oblique rotation, which generated a 3-component solution accounting for 58% of the total variance. Subtests loading on a component termed Individual Item Identification were most similar to classical cancellation tasks, whereas subtests loading on the second component, Verbal Sequencing, involved (or would be aided by) reading skills. These 2 components were moderately correlated, suggesting that they may represent different aspects of the same underlying construct, or 2 closely related skills. Neither was highly correlated with the third component, termed Complex Visual/Nonverbal

Sequencing. These results support the hypothesis that different subtests of the UT tap more than a single cognitive construct. The results of a confirmatory factor analysis designed to test various explanatory models of the construct dimensions of the UT will also be presented.
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M. EVANS. Are Psychometric Tools Measuring the Memory Processes That We Think They Are?
Typically in cognitive assessments, reading achievement has been found to be strongly associated with measures of processing speed (PS), short-term memory (STM), and working memory (WM). In this study, performance on the Letter Word Identification (LWID) task from the Woodcock Johnson Achievement Battery–Revised was administered to Grade 2 and 3 children ($N = 92$) to discriminate among 2 groups: (1) good readers (>75th percentile); and (2) poor readers (<26th percentile). RAN digits was administered to measure PS, while digit forward and digit backward from the digit span subtest of the Wechsler Intelligence Scale–3rd Edition (WISC–III) were used to measure a child's STM and WM capacity, respectively. Using a Principal Components Factor Analysis (PCA) it was revealed that in good readers RAN digits, digit forward and digit backward made up one factor that was interpreted as PS. In contrast, for poor readers, RAN digits measured PS, while digits forward appeared to measure STM and digits backward assessed WM capacity. What psychometric tools a clinician may assume to measure PS, STM, and WM during a cognitive assessment may in fact differ depending on what type of reader is being assessed.
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A.L. ALBERT, J.N. BROWNDYKE, K.A. TUCKER, R.H. PAUL, & W.D. GOUVIER. Computer-Related Anxiety and Outcome on a Computerized Neuropsychological Assessment Measure.
As computerized neuropsychological assessment procedures gain in popularity, it will become increasingly important to determine what variables or attitudes specific to the computerized testing environment may impact performance. In an attempt to address one of the suspected confounds unique to computerized assessment, the current study was conducted to elucidate any possible relationship between computer- and technology-specific anxiety and task performance on a computerized version of a well-known neuropsychological assessment measure—the Remote Neuropsychological Assessment–Category Test (RNA–CT). Computer- and technology-related anxiety and cognition data was collected using the Computer Anxiety Rating Scale (CARS), a multifactorial self-report measure tapping anxiety and negative attitudes specific to computers and technology, and outcome on this measure was compared with RNA–CT error scores and response timing variables in normals ($n = 20$) and in individuals with a history of neurological or psychiatric difficulties ($n = 21$). The result of multivariate analyses, controlling for finger tapping speed and fine manual dexterity, revealed a significant interaction between group status and computer-related anxiety level for the RNA–CT response timing variables, but not for RNA–CT total or subtest error scores. These results, when combined with prior research in the area of anxiety and computer mediated task performance, suggest that as computer- and technology-related anxiety and negative attitude levels increase, test performances may decrease, particularly in individuals with neurological or psychiatric conditions, but only for those task components which are time dependent.
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D. TUCKER & R. JONAS. Cognitive Processes Assessed by the Paced Auditory Serial Addition Test.
This study attempts to dismantle the Paced Auditory Serial Addition Test (PASAT) to determine the relative contribution to performance of the following cognitive constructs: working memory, dual processing, vigilance, sustained attention, and speed of retrieval from both long-term memory and working memory. A normative sample of 64 college students (mean age = 18.30 years, M/F ratio = 23/41) were administered a variety of clinical and experimental measures including the WAIS–III Digit Span (working memory), Trail Making, Part B, and WAIS–III Letter-Number Sequencing (dual processing). Speed of retrieval from long-term memory was assessed by measuring the response time needed to sum 2 single digit numbers in "unpaced" trials. Scanning and retrieval speed from working memory was measured using an adaptation of Sternberg's (1969) memory scanning task. Vigilance and sustained attention were measured by comparing split-half performance differences on selected tasks. Regression analysis was used to predict performance on each trial of the PASAT using college entrance SAT scores as a covariate to control for intelligence. Results indicated that retrieval speed of math facts accounted for the greatest amount of variance for all trials. While working memory accounted for a significant amount of variance for the first trial, dual processing accounted for a significant amount of variance for trials three and four. These findings suggest that PASAT performance is primarily dependent on retrieval speed of math facts, but working memory and dual processing have differential contribution depending on the particular trial. Implications for the interpretation of PASAT performance in clinical populations will be discussed.
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N. AWAD, M. TSIAKAS, M. GAGNON, & C. MESSIER. Explicit Scoring Criteria for the Taylor Complex Figure Test.
An explicit scoring criteria was devised for the Taylor Complex Figure Test (TCFT) in order to improve and operationally define the original scoring criteria initially devised by Taylor (1979). The current scoring criteria was designed to be equivalent in clarity and precision to the most recent version of the scoring criteria for the Rey-Osterrieth Complex Figure Test (ROCFT). The original scoring units were expanded and detailed to address the distinction between placement and accuracy for each scoring component. An 18-item version of the scoring criteria is presented using scores of 0, 0.5, 1, and 2 for accuracy and placement (the higher the accuracy and placement, the higher the resulting score). Seventy university students were randomly selected from a larger study aimed at determining the effect of glucoregulation on memory functions (Messier et al., 2001). Although no differences were observed in absolute scores between the original and the present criteria version, the present scoring criteria facilitates the scoring and provides additional information for qualitative analysis. Such explicit scoring criteria can be used to improve the reliability of clinical and research investigations.
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M. GAGNON, N. AWAD, M. TSIAKAS, & C. MESSIER. The Taylor Complex Figure Is Not Equivalent to the Rey-Osterrieth Complex Figure.
Previous studies have determined the comparability of the copy versions of the Taylor Complex Figure Test (TCFT) and the Rey Complex Figure Test (RCFT) but the findings showed that delayed recall of the TCFT was easier than the delayed recall of the RCFT. Using a comprehensive and explicit scoring criteria devised for the TCFT (Awad et al.), the performance of 100 university students was compared for the copy, immediate recall, and delayed recall of the TCFT and the RCFT. Subjects were selected for a larger study aimed at determining the effect of glucoregulation on memory function (Messier et al., 2001). Presentation of the figures was counterbalanced across subjects. No differences were observed between the copy phase of the RCFT and TCFT. However, when comparing performance on the immediate and delayed recall, subjects recalled more details (i.e., placement and accuracy) of the TCFT than of the RCFT. The results confirm that although the visuospatial organization of both figures

is comparable in difficulty, the details of the TCFT are more readily accessible for recall than the details of the RCFT, even following a short delay of 3 minutes. These results are clinically relevant given that psychologists and neuropschologists use both tests as alternate forms during assessments. The fact that the sample was based on a nonpatient population improves the validity of the effect obtained.

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N. AWAD, M. GAGNON, M. TSIAKAS, & C. MESSIER. Addressing the Differences in Speed of Processing of the Intervening Calculation Task on the Modified Brown-Peterson Test.

Although one goal of the Modified Brown-Peterson Test (MBPT) is to evaluate the number of consonants recalled following a distracting calculation task, previous research has not addressed the effect of individual differences in processing speed for the intervening calculations. The goal of the study was to determine whether the number of calculations performed during an intervening task is related to the recall performance on the MBPT. The sample consisted of 62 university students randomly selected from a larger study aimed at determining the effect of glucoregulation on memory functions (Messier et al., 2001). A computerized version of the MBPT and the arithmetic subtest of the Wechsler Adult Intelligence Scale III were administered to all subjects. The computerized version of the MBPT consisted of 4 practice trials and 14 experimental trials. Letters were presented in an auditory fashion to the subjects at the rate of 1 letter per second. Subjects were instructed to subtract by 3s from a predetermined number as quickly as they could for a period of 20 seconds after which time they had to recall the consonants initially presented. Results showed that although the numbers of calculations performed was not related to the recall performance of consonants, performance was correlated with scores on the arithmetic test. As such, the ease with which an individual performs subtractions does not reflect the amount of interference created by the dual-information processing. Instead, the number of calculations performed appears to reflect the individual's level of arithmetic skill.

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J. HALE, J. HOEPPNER, & C. FIORELLO. Analyzing Digit Span Components for Assessment of Attention Problems.

The Digit Span (DS) subtest is thought to measure auditory attention, concentration, sequencing, and short-term memory. While further analysis reveals DS assesses several neuropsychological constructs, its utility in differential diagnosis has been questioned because poor performance has been inconsistently associated with attention and executive problems. In this study of 191 children referred for comprehensive neuropsychological evaluations, Digits Forward (DF), Digits Backward (DB), and Forward-Backward Difference (DD) component scores were found to be differentially predictive of attention, executive function, and behavior rating scale measures. Only DB was predictive of Gordon Diagnostic System Vigilance Correct ($\beta = .36$; Partial $r_{xy} = .34$; $F = 15.99$, $p < .001$) and Commissions ($\beta = -.24$; Partial $r_{xy} = -.23$; $F = 6.96$, $p = .009$). Trails B Time ($\beta = -.52$; Partial $r_{xy} = -.45$; $F = 16.42$, $p < .001$) and Errors ($\beta = -.28$; Partial $r_{xy} = -.25$; $F = 4.04$, $p = .049$), and the Achenbach Teacher Report Form Attention Problems Subscale ($\beta = -.38$; Partial $r_{xy} = -.34$; $F = 15.71$, $p < .001$). Results suggest children with attention problems have working memory or executive function deficits as measured by DB, not rote auditory memory deficits tapped by DF. Collapsing DS components into subtest scaled scores may obscure important diagnostic information and limit accurate identification of children with attention problems.

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D. J. SCHRETLEN, C.A. MUNRO, & G.D. PEARLSON. How Much Intra-Individual Variability in Cognitive Test Performance is Normal?

Neuropsychologists often diagnose cerebral dysfunction based, in part, on extreme variation in an individual's cognitive test performance. However, relatively little is known about what constitutes the normal range of such intra-individual variation. In this study, 32 age-residualized, *z*-transformed neuropsychological test scores (derived from 15 different tests) were derived for each of 248 adults who participated in an ongoing study of normal aging. After excluding 54 participants with severe health problems or a MMSE score below 24/30, the distribution of each remaining person's test scores was reviewed. Next, the difference between each person's highest and lowest scores was computed to assess the maximum discrepancy (MD) shown by that person. The resulting MD scores ranged from 1.5 to 6.5, meaning that the least maximum discrepancy shown by any person was 1.5 standard deviations and the greatest maximum discrepancy shown by any person was 6.5 *SD*. Over 50% of persons produced MD scores of $\geq$3.0, and 13% produced MD scores of $\geq$4.0 (e.g., standard scores ranging from 60 to 120). To assess whether a few anomalous test performances inflated the range of MD scores, the latter were recomputed after eliminating each person's 2 or 3 most extreme test performances. This decreased the mean MD score from 3.1 to 2.7, although 25% still produced MD scores of 3.0 or more. These findings suggest that marked intra-individual variability is common in normal adults. They also underscore the importance of basing interpretation on clinically recognizable patterns of test performance rather than psychometric variability alone.

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M. McCLAIN & F.W. BLACK. The Effect of Mood on Symptom Validity Test Performance.

Evaluation of the validity of test results is an essential element in neuropsychological practice. Questions of validity are of foremost importance when evaluations occur within a legal context; neuropsychologists practicing in the legal arena must provide evidence regarding the patient's apparent level of motivation and the subsequent effect on the overall test results. However, the effects of mood on symptom validity test performance has not been studied systematically. The current study examined relationships between performance on the Word Memory Test (WMT), the Test of Memory Malingering (TOMM), measures of mood (BDI, BAI), physical functioning (Wahler Physical Symptoms Inventory), attention (Brief Test of Attention, WMS–III Working Memory Index) and memory (AVLT). Subjects were 38 patients (69% male, mean age 38, mean education 12 years) seen for neuropsychological evaluation in our laboratory. All subjects but one were litigating. Results of hierarchical regression indicate that anxiety, as measured by the Beck Anxiety Scale, accounts for a significant portion of the variance on WMT scores for immediate [$F(3,25) = 3.21$, $p = .04$] and delayed recognition [$F(3,25) = 4.77$, $p = .009$] as well as response consistency [$F(3,24) = 3.66$, $p = .026$]. In addition, scores on the BDI were predictive of performance on all 3 trials of the TOMM. Performance on mood measures was not predictive of scores on attention or memory measures. These findings raise important issues regarding the clinical application of these measures of symptom validity.

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T. WOLBERS, A. KRONEMANN, J. KUEST, H. KARBE, J. NETZ, & V. HOEMBERG. The Effects of Exploratory Eye Movements on the Driving Ability of Patients with Homonymous Hemianopia.

According to the legal situation in many countries throughout the world, the driving license of patients suffering from homonymous hemianopia is revoked if their visual field size does not exceed 120° of visual angle. This practice does not take into account the fact that in everyday life, many patients are able to compensate for their deficits by making exploratory saccades into the blind hemifield. This occurs either spontaneously or after successful visual exploration training. Therefore, the question must

be raised whether the described practice is justified or whether each case should be considered individually. In the present study, we used an interactive driving simulator to examine driving ability in 2 groups of hemianopic patients. Compared to healthy control subjects, patients with exploratory deficits displayed impaired driving performance in 8 out of 18 driving categories. In contrast, no significant differences were found between patients who compensated for their deficits and the control group. These results were interpreted as revealing that (1) visual field defects severely impair driving ability and (2) that patients who compensate for their deficts are able to meet the requirements of modern traffic, thus questioning the adequacy of the current practice in many countries. Several authors argue that unconscious motion perception via extrastriate visual pathways might be responsible for the good driving performance of hemianopic patients. In light of our result that only those patients drove adequately who compensated for their deficits by making exploratory saccades, we believe that conscious processing of traffic-relevant stimuli is a necessary prerequisite for unimpaired driving.

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M.R. BASSO, F. CARONA, M. MATSON, N. LOWERY, C. GHORMLEY, J. PACE, & B.N. AXELROD. Practice Effects of WMS–III Measures Across 3 and 6 Months.

Although neuropsychologists frequently re-evaluate memory across time, relatively little is known regarding practice effects on commonly administered memory tests. The publishers of the WMS–III addressed this issue, and administered the test twice over 12 weeks to 394 participants. With the exception of the Working Memory Index, participants displayed significant increases on all index scores. Notably, scores increased from 5 to 15 points across the WMS–III Indexes. Such considerable increases notwithstanding, it remains uncertain whether similar increments occur over longer periods of time. In particular, memory for testing tasks likely mediates practice effects, and recall tends to diminish over time. Since most clinical re-evaluations take place over 6 or 12 months rather than 12 weeks (as previously examined), this seems especially relevant. In the present study, 53 adults (ages 17–53) participated. Half were administered Logical Memory and Faces from the WMS–III over 3 months, and half were re-evaluated after 6 months. Groups were equivalent in age, education, gender, and baseline scores on the WMS–III subtests. Data were analyzed using the ANOVA model, and revealed that scores on both subtests increased significantly across time. On average, age-corrected scaled scores increased from $M = 10$ to $M = 11.5$. Nonetheless, individuals retested after 3 months showed more improvement than those retested after 6 months, with scores in the former group increasing to 12, and those in the latter increasing to only 11. This suggests that the effects of practice on these WMS–III subtests diminish across time. Implications for clinical and research applications are discussed.

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R. DAVIS, P. MASSMAN, & R. DOODY. Measurement Invariance of the WAIS–R in AD Among Patients at Higher *versus* Lower Levels of Dementia Severity.

The extent to which a test measures the same construct(s) in different groups (measurement invariance) is often not assessed. Even if a test has the same factor structure in 2 groups, the indicators of each factor may still load to quite different degrees in each group. This study assessed the extent of measurement invariance using an expanded Satz-Mogel short form of the WAIS–R in samples of patients with Alzheimer's disease (AD) at higher (MMSE ≤ 20; $n = 259$) *vs.* lower (MMSE ≥ 21; $n = 253$) levels of dementia severity. A 3-factor model in which Digit Symbol loaded on a Perceptual Organization, rather than a Freedom from Distractibility factor, was shown to fit the data best in the 2 samples. Equality constraints tested included forcing the factor covariances to be equal, and forcing the factor loadings to be equal in both groups. Constraining the factor covariances to be equal did not yield a significant decrement in model fit, whereas constraining the factor loadings to be equal did. In light of this finding, the extent of partial measurement invariance was assessed, in which the factor loadings were constrained to be equal 1 subtest at a time. The 2 groups evidenced significantly different factor loadings on 4 subtests: Comprehension, Digit Symbol, Picture Arrangement, and Object Assembly. Each test loaded more highly on its respective factor in the more severely demented group. These findings support the notion of measurement invariance for the WAIS–R among patients at higher *vs.* lower levels of dementia severity for its overall factor structure and covariances, whereas only partial measurement invariance is evident for factor loadings.

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Poster Session 1/4:00–7:00 p.m.

HIV/AIDS

S. MURJI, J. DONDERS, D. SHORE, S. CARTER, & S. ROURKE. Theoretically Derived Memory (CVLT) Subtypes in HIV Infection.

The present study sought to delineate empirically derived memory subtypes using the California Verbal Learning Test (CVLT; Delis et al., 1987) in a sample of adults with HIV infection ($N = 154$). Confirmatory factor analysis was used to evaluate 8 models of the CVLT structure suggested by Wiegner and Donders (1999). A 4-factor model, consisting of Attention Span, Learning Efficiency, Delayed Recall, and Inaccurate Recall appeared to be the best fitting model. Variables with the highest factor loadings from the model were entered in a 2-stage cluster analysis. Four reliable CVLT subtypes were identified: Normal ($n = 36$), Atypical ($n = 42$), Subsyndromal ($n = 46$), and Frontal-Striatal ($n = 19$). Internal and external validation indicated that subtypes were stable and clinically meaningful: Normal subtype displayed intact neuropsychological performance; Atypical subtype was characterized by psychomotor slowing; Subsyndromal subtype exhibited "spotty" neuropsychological impairments; and Frontal-Striatal subtype had impairments in psychomotor efficiency, category fluency, and executive skills, as well as lower educational achievement and elevated depressive symptoms. Subtypes did not differ significantly with respect to subjective neurocognitive complaints or markers of HIV disease. The present findings highlight the heterogeneity of memory profiles in HIV infection and suggest that the "subcortical" *versus* "cortical" conceptualization of memory performance may be too simplistic. The identification of robust memory subtypes in HIV infection may lead to improved diagnostic accuracy of HIV-1-associated cognitive motor complex (American Academy of Neurology, 1991).

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A. SCHILLER & W.J. BURNS. HIV/AIDS Memory Performance: A Standardization Sample Comparison.

The present study was designed to determine if any deficits in memory function were evident in an HIV/AIDS sample in comparison to a standardized sample. Therefore, the memory functioning of 20 HIV+ (19 male, 1 female) volunteers was compared to the standardization sample of the Wechsler Memory Scale–Third Edition (WMS–III). The mean age of this HIV+ sample was 46.7 years (range: 31–62) and the mean education was 13.5 years (range: 8–18). Data were analyzed using one-sample *t* tests for the entire group as well as for subsamples of CDC classification groups (i.e., CDC–A = asymptomatic, CDC–B = mildly symptomatic, CDC–C = AIDS). The entire sample was found to differ significantly from the standardization sample on General Memory, Immediate Memory, Visual Immediate Memory, and Visual Delayed Memory indices. The asymptomatic group differed significantly on only the Visual Immediate Memory index. The mildly symptomatic group did not differ significantly on any memory indices. The AIDS group, like the asymptomatics, differed only on the Visual Immediate Memory index. Graphical examination of memory performance of each group revealed that the AIDS group, overall, performed

better than the mildly symptomatic group, which performed better than the asymptomatic group. However, the AIDS group did show a decline in Visual Immediate and Delayed Memory indices to levels equivalent to or less than the mildly symptomatic group. In sum, visual memory appears most sensitive to HIV/AIDS.

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A. EFENDOV, R. JOSHI, B. LANCEE, D. SAUNDERS, & S. ROURKE. Neurobehavioral Correlates of Medication Management in HIV-Infection.

The purpose of this study was: (1) to examine the neuropsychological (NP) correlates of the Medication Management Test (MMT; Albert et al., 1999); and (2) to examine the association of NP, MMT, and depression (Beck Depression Inventory) with medication adherence to highly active antiretroviral therapy (HAART) in adults ($N = 74$) with HIV-infection. Participants completed NP tests of attention and working memory, psychomotor speed, and learning efficiency, as well as dispensing and inference components of the MMT. Adherence was measured using the UCSF Adherence Questionnaire (ACTG), a 1-week retrospective self-report questionnaire. Sample mean age and education was 41.5 ($SD = 7.4$) and 13.3 ($SD = 2.4$), respectively. *Results:* (1) NP measures of attention and working memory, learning efficiency, and psychomotor skills, but not depression, were significantly associated with MMT inference and dispensing components; (2) Among those with nonadherence to HAART ($n = 21$), performance on both the dispensing and inference components of the MMT were significantly correlated with tests of attention and working memory, psychomotor speed, and learning efficiency; and (3) Adherence behavior was not correlated with NP, MMT, or depression. *Conclusions and implications:* The MMT is an instrumental activities of daily living clinical tool to assess patients' ability to manage medications. While performance on the MMT is related to NP skills, our results did not support an association with self-reported HAART adherence. Understanding adherence behavior may require addressing not only NP abilities but also factors such as social support, willingness to adhere, expectation regarding medication effectiveness, mental health, and daily routines that may also affect medication adherence.

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S. CARTER, D. SHORE, S. MURJI, & S. ROURKE. Cognitive Complaints in HIV Infection: A SEM Analysis.

The main objective of this study was to use structural equation modeling (SEM) to clarify the nature of the relationship between subjective cognitive complaints and actual neuropsychological skills in 156 HIV-infected adults, of whom 18 were asymptomatic (CDC-A), 61 were mildly symptomatic (CDC-B), and 76 had AIDS. Participants completed questionnaires assessing cognitive complaints, symptoms of depression, and HIV-related systemic medical symptoms. Neuropsychological tests included measures of attention, verbal fluency, psychomotor skills, learning, memory, and executive skills. SEM was used to test models of the relationships among cognitive complaints, mood, and systemic medical symptoms with neuropsychological functioning. Selection of the final model was based on fit indices, residuals, and theoretical soundness. The model indicated that while depressed mood ($\beta = 0.30$, $p < .01$) and systemic medical symptoms ($\beta = 0.32$, $p < .001$) influenced cognitive complaints, cognitive complaints independently predicted poorer neuropsychological performance ($\beta = 0.44$, $p < .01$). Mood and systemic medical symptoms were significantly correlated ($r = 0.43$, $p < .001$) but did not significantly predict neuropsychological skills. The implications for the predictive value of cognitive complaints and the identification of individuals at risk for HIV-associated neuropsychological impairment are discussed.

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L. TRÉPANIER, S. KRZYZANOWSKI, A. BAYOUMI, & S. ROURKE. Impact of Neuropsychological Impairment and Depression on Quality of Life in HIV.

Objective: To examine the impact of depression (DEP) and neuropsychological (NP) impairment on health-related quality of life (HRQOL) in 173 HIV-infected adults. *Methods:* Participants received a NP examination, the Beck Depression Inventory (BDI), and the Medical Outcomes Study (MOS) HIV Quality of Life instrument. Global NP status was defined using Henton's clinical rating system. Presence of depression was defined by a BDI score >10 on the first 13 items. A principal components analysis of MOS-HIV data confirmed Revicki's recent work in HIV-infection, supporting the use of 2 major HRQOL factors, Physical Health (PH) and Mental Health (MH). MANOVA was used to examine the independent and interactive effects of NP status (normal/impaired) and DEP (present/absent) on the PH and MH dimensions. *Results:* MANOVA results: significant interaction between DEP and NP status ($p < .007$) and main effect for DEP ($p < .0001$) but no main effect for NP status. Follow-up ANOVA results for the MH factor revealed a significant main effect for DEP ($p < .001$) and a significant DEP $\times$ NP status interaction ($p < .05$). ANOVA results for the PH factor revealed a significant DEP $\times$ NP status interaction ($p < .008$) and a trend for the main effect of NP status ($p = .05$). *Conclusions:* DEP significantly reduced Mental Health outcome. Physical Health outcome was only affected when both DEP and NP impairment were present. Presence of NP impairment without DEP had no apparent impact on either HRQOL factor. Results confirm the importance of DEP and NP status as determinants of HRQOL and aid in guiding treatment strategies for HIV-infected individuals.

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K. MASON, D. THRASHER, S. CASTELLON, M. LAM, D. HARDY, M. STEFANIAK, R. DURVASULA, & C. HINKIN. Neurocognitive and Neuropsychiatric Predictors of Adherence in HIV+ Men and Women.

The successful treatment of individuals infected with HIV requires strict adherence to highly active antiretroviral therapy (HAART) regimens. Identifying those factors that predict medication adherence is critical to preventing the development of HAART-resistant HIV mutations and diminished health status. It has been hypothesized that the factors that predict adherence in men may differ from those that predict adherence in women. For example, mood and psychosocial variables, such as SES, access to health care and social support may differentially predict adherence in women. The current study examined neurocognitive and neuropsychiatric predictors of adherence in HIV+ men *versus* women. All participants ($N = 116$) were administered a battery of neuropsychological tests. Test scores were submitted to principal components analysis followed by a promax rotation. The 4 factors that emerged appear to represent psychomotor speed, executive functioning, memory, and mood. A strong relationship was found between psychomotor speed ($r = -.41$), mood ($r = -.39$) and adherence in HIV+ women. Exploring the mood factor more closely in women, apathy and depression appear to be responsible for the relationship to adherence (BDI-2 and Apathy: $r = -.45$). Among the HIV+ men, executive functioning was most strongly associated with adherence. In our sample of HIV+ women, poor adherers were found to have less education, a higher incidence of current drug/alcohol abuse, and more complex medication regimens. This pattern was not found in our sample of men who were poor adherers. As such, it appears that differing sets of neurocognitive and psychosocial variables predict medication adherence in HIV+ men *versus* women.

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A. NOE, M. SEIDENBERG, L. THORPE, L. MULLEN-CULKITT, K. WALSH, R. HEWITT, & R.H.B. BENEDICT. Automobile Driving is Preserved in Cognitively Impaired HIV-1 Positive Patients.
Cognitive impairment is a well documented consequence of HIV-1 infection. More poorly understood is the impact of cognitive impairment on activities of daily living. The current study investigated the impact of cognitive functioning on automobile driving in 42 HIV positive men. Assessment consisted of neuropsychological (NP) testing and an on-road driving examination. During the driving evaluation, patients followed a standard route under the direction of a licensed occupational therapist. Patients were then "challenged" by being asked to navigate their way back to the clinic. NP testing revealed impairments in multiple cognitive domains, particularly new learning and attention. Pearson correlations showed a significant relationship between a test of visual attention and processing speed and total error score derived from the driving exam. Regression analyses also revealed that driving performance was significantly predicted by an index of spatial ability, after controlling for demographic and disease-related variables, and estimated intelligence. However, while errors were encountered on the driving exam, all subjects were judged to have passed according to clinical judgment and total score. Closer examination of the "standard" *versus* "challenge" sections of the driving exam indicated that more serious errors were committed during the challenge section, which occupied a fraction of the time of the standard section. In conclusion, the findings confirm an association between spatial ability and driving skills, but suggest that driving is not defective in HIV patients with mild to moderate cognitive impairment. The meaning of this conclusion in the context of recent driving simulator research is discussed.
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R. DUWORS & R. COHEN. Analysis of Efficacy of Various HAART Medication Regimens on Neurocognitive Performance With Women With CD4 T Cell Counts Below 100.
A semiannual neurocognitive examination of 4 tasks was administered to women with HIV whose T cell counts fell below 100: Color Trail Making, Controlled Oral Word Association, Grooved Pegboard, and Four Word Learning. Those receiving a combination of nucleoside analogues and nonnucleoside reverse transcriptase inhibitors had better results on verbal fluency, motor functioning and executive functioning than individuals receiving a combination of nucleoside analogues and protease inhibitors and better than those receiving a combination of protease inhibitors, nucleoside analogues, and nonnucleoside reverse transcriptase inhibitors. Previously published data from this study (see Cohen, R. (2001) *AIDS 15*, 341–345) found that the women in this study taking highly active anti retroviral therapy (HAART) for 18 months or longer showed the most robust neurocognitive functioning on measures of verbal fluency, motor functioning, and executive functions. HAART-treated women had improved neurocognitive functioning when compared to those not treated with HAART. Those functions deteriorated among women not taking HAART. HAART was not available at the initiation of this study, and 44% reported treatment with HAART at their most recent visit. The mean duration of HAART was 36.3 ± 12.6 months. This neuropsychological evaluation was initiated when a woman's CD4 T cell count fell at $< 100 \times 10{,}000{,}000$ cells, as a part of the HIV Epidemiological Research Study (HERS). Sample size was limited, 125. Consequently, some cell sizes were particularly small. Nevertheless, this study yielded data around differences in neurocognitive performance outcomes within HAART regimen combinations to warrant further investigation.
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M. CHILDERS, R. ELLIS, R. DEUTSCH, T. WOLFSON, I. GRANT, & THE HNRC GROUP. The Utility and Limitations of the HIV Dementia Scale.
Background: The HIV Dementia Scale (HDS) is a brief instrument designed to identify HIV-associated cognitive impairment. *Objectives:* We assessed the scale's utility by comparing HDS scores to global impairment ratings derived from a comprehensive neuropsychological (NP) test battery. *Methods:* Subjects were 164 HIV-seropositive men and 40 women enrolled in a prospective, longitudinal research study. Each completed the HDS and a comprehensive battery of standardized neuropsychological tests. Demographically-corrected NP test scores were used to assign a clinical global NP rating of "impaired" or "not impaired", against which HDS scores were evaluated. In using an HDS cutoff score to identify impaired subjects, sensitivity was judged to be more important than specificity (i.e., a high proportion of HDS-impaired subjects would be impaired based on global NP ratings). For identifying unimpaired subjects, specificity was judged to be more important (i.e., a high proportion of HDS-unimpaired subjects would be unimpaired on global NP ratings). *Results:* HDS scores below 11 demonstrated 97% sensitivity and 32% specificity in identifying subjects with global NP impairment. HDS scores above 15 showed 61% sensitivity and 81% specificity in identifying those without NP impairment. Scores equal to and between 11 and 15 (44% of subjects) were indeterminate. HDS scores were significantly related to education and ethnicity. *Conclusions:* Given the caveats noted above, the HDS may be used to quickly confirm impairment status when the clinician reasonably suspects impairment or nonimpairment, and patients are unable to complete more extensive neuropsychological testing.
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Paper Session 1/4:30–6:15 p.m.

MEMORY

D. SHUM & A. MAUJEAN. Effects of Working-Memory Demand on Prospective-Memory in Individuals with TBI.
This study aimed to examine the effects of working-memory demand on prospective-memory task performance in individuals with TBI. Thirteen individuals with moderate to severe TBI and 13 matched controls were administered a lexical-decision task and an event-based prospective-memory task on a computer. The lexical decision task was used as an on-going task and had 2 levels of working-memory demand. In the low-demand condition, participants had to decide if 4 letters presented simultaneously on the screen was a word or a nonword. In the high-demand condition, they had to decide if a sequence of 4 letters (presented one letter at a time on the screen) was a word or a nonword. The event-based prospective memory task involved pressing a key whenever a target stimulus (viz., a 4-letter animal word) appeared. The participants were also administered the Letter Number Sequencing Test, the Tower of London, and the Controlled Oral Word Association Test to examine the relationships between prospective memory and prefrontal-lobe functions. Results obtained indicated that participants in the TBI group performed significantly more poorly than participants in the control group in the high but not low working-memory demand condition. Significant correlations were found between prospective-memory task performance with scores on the Letter Number Sequencing Test and the Controlled Oral Word Test. Results of the study suggest that prospective-memory impaired in individuals with TBI is related to the working-memory demand of the ongoing activities and some prefrontal-lobe functions. The theoretical and practical implications of these findings will be discussed.
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F. CONSTANTINIDOU & S. BAKER. Stimulus Modality and Verbal Learning Performance in Normal Aging.
Research paradigms incorporating multi-trial learning tasks like the Auditory Verbal Learning Test (AVLT), were reported sensitive in assessing learning in clinical populations with brain injury, learning disabilities, and depression. This study investigated the effects of modality presentation on the verbal learning of older, neurologically intact adults and younger co-

horts. A multi-trial free-recall paradigm was implemented incorporating 3 modalities: Auditory, Visual, and simultaneous Auditory plus Visual. Twenty-five males (ages 50–77, $M = 62.9$, $SD = 7.5$) and 25 males ages 19–38 ($M = 25.32$, $SD = 4.22$) participated. Results of the mixed model MANOVA indicated that older subjects learned significantly fewer words than younger subjects across the 3 modalities ($p < .0001$). However, the rate of learning was similar between the 2 groups ($p = .667$). All subjects learned significantly more items during the visual presentation (with or without the simultaneous auditory presentation of names) ($p < .0001$). Furthermore, the visual presentation was the most resistive to retroactive interference ($p < .0001$) and to the effects of 30-min delay ($p < .0001$). While the normal aging process did not produce a pronounced retroactive interference effect ($p = .122$), a 30-min delay resulted in a significant decline in performance for the older group ($p < .0001$). Retrieval more than retention difficulties contributed to the decline in performance of older subjects since their recognition score was significantly better than their free recall ($p < .0001$). These findings suggest that pictorial presentation may provide additional support and enhance memory performance in older adults.

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A.K. TROYER, F.I.M. CRAIK, & M. J. CADIEUX. Levels of Processing and Memory for Surnames Among Older and Younger Adults.

As people grow older, a common complaint is increased difficulty learning and remembering names. Previous research has indicated that words are remembered better if processed at a deep level (i.e., according to their meaning) rather than at a shallow level (i.e., according to their appearance or sound). This idea of "levels of processing" was applied to learning and remembering new surnames. Older adults (mean age 72) and younger adults (mean age 21) were presented with surnames. For each name, participants were instructed to (a) state the first letter of the name, (b) generate a word that rhymes with the name, (c) describe what the name means, or (d) learn the name. Eight names were presented in each of these 4 conditions. Presentation was followed by a 20-second distractor task, a recall test, and a recognition test. A significant level of processing effect was obtained by both age groups for both recall and recognition, with lowest performance in the Letter condition, intermediate performance in the Rhyme condition, and highest performance in the Meaning condition. Age differences in recall and recognition favoring the young were obtained in the Learn condition but not in the other condition. The combination of processing meaning during encoding and using recognition during retrieval was especially advantageous to the older adults; in this condition, performance was numerically (but not significantly) better among the older than the younger adults. Findings suggest that processing names at the level of their meanings could be a useful mnemonic strategy for older adults.

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B. J. DIAMOND, J. DeLUCA, & C. FISHER. Recall of Past Events During and After Confabulation.

Anterior communicating artery (ACoA) aneurysm can be accompanied by impairments in memory and executive function. Some patients exhibit confabulation. Our goal was to characterize memory during and after confabulation in patient FP using the Confabulation, Autobiographical and Retrograde Scale (CARS). Patient FP was a 64-year-old female who suffered a ruptured and repaired ACoA aneurysm. Four ACoA subjects matched with FP on intelligence, age, and education served as clinical controls. FP was evaluated at 2 months post-surgery during confabulation and then at 24 months post when she no longer confabulated. FP was profoundly impaired on verbal (i.e., CVLT), and visual recall (ROCFT) and on the WCST (i.e., achieving 0 categories) as well as on verbal fluency (i.e., Controlled Oral Word Association test: 6 and 8 words, respectively) both during and after confabulation. During confabulation, FP was impaired on: questions tapping orientation, early adolescence, vocational experience, marriage-related information, and on response reliability (i.e., consistency). On recall of public information relating to people, places or events from the 1930's, 40's or 50's she was similar to controls, but was impaired on information from the 60's, 70's, and 80's. After confabulation, FP showed significant improvement on questions relating to early adolescence, vocational, marriage, and recent events. Little change occurred on public information. Dramatic improvement was shown on response reliability (i.e., 4 *SD*s). Taken together, these findings indicate that after confabulation, FP showed improved recall of recent events and greater response consistency. That is, after confabulation, the processes mediating retrieval appeared to be more efficient.

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M. CHEUNG & A. CHAN. Memory is Not Only Mediated by the Hippocampus But Also Its Surrounding Cortex.

While it is well understood that the hippocampus is crucial for encoding new information, whether its surrounding cortex is significant for learning and memory remains a big debate. Zola-Morgan and his colleagues (1982) compared monkeys having hippocampal lesions with those having lesions of the surrounding cortex and reported that only the hippocampus but not its surrounding cortex was vital for learning. However, others reported inconsistent results. To explore this issue, 16 patients receiving radiotherapy for nasopharyngeal carcinoma were recruited in the present study. Analyses of their MRI scans with the Talairach templates showed that 5 patients had bilateral temporal lobe damage but sparing the hippocampus (BTL) while 5 patients had bilateral lesions over the temporal lobes and the hippocampus (BTL+H). Six patients, who did not develop lesions after radiotherapy, were also included (NEG) as controls. Their learning and memory was assessed by the immediate and 30-min delayed recall trials of 2 verbal (i.e., Hong Kong List Learning Test [HKLLT] and a story recall test) and 2 visual (Visual Reproduction subtest of WMS–R and Brief Visuospatial Memory Test–Revised) memory tests. The performance of both BTL (mean: 34.58%) and BTL+H (mean: 29.69%) patients was significantly poorer than that of NEG (mean: 60.76%) on the immediate recall of HKLLT. The performance of BTL and BTL+H patients was not significantly different. A similar pattern of results was observed on other memory tests. Thus, the present study seems to support the notion that the temporal cortex surrounding the hippocampus is substantial for learning and memory.

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S. HEPWORTH & M.L. SMITH. Learning and Recall of Story Content and Spatial Location After Unilateral Temporal Lobe Excision in Children and Adolescents.

Deficits in learning and memory following temporal-lobe lesions in adulthood have been consistently reported, but findings in children are more equivocal. The discrepancy may reflect the sensitivity of tests used, sample characteristics, and/or extent of neural plasticity. We investigated verbal and spatial learning and recall in children and adolescents who had undergone unilateral temporal lobectomy for intractable seizures. A total of 33 participants matched for age and education (9 left temporal, 8 right temporal, and 16 controls) were given a short story and a spatial array of pictures to learn to criterion and recall after a 30-min delay. The left temporal lobe group did not differ from the right temporal or control group on the verbal task. However, the right temporal lobe group recalled fewer details than the control group on free recall of the story after the delay. Furthermore, the right temporal-lobe group had more difficulty learning, but not retaining, spatial information compared to the left temporal and control groups. Age of seizure onset and age at surgery were negatively correlated with learning efficiency on the verbal task for the right temporal-lobe group; these variables did not correlate with performance on either task in the left temporal group. The results provide partial support for the theory that the right hemisphere has a more protracted period for neural

plasticity than the left hemisphere (Strauss et al., 1990). These findings also highlight the differences between the effects of lesions of the temporal lobe on memory in children and adults.
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H.R. GRIFFITH, R. PYZALSKI, D. O'LEARY, V. MAGNOTTA, P. RUTECKI, R. SHETH, B. BELL, C. DOW, G. WENDT, M. SEIDENBERG, & B. HERMANN. The Parahippocampal Gyrus and Semantic Memory in Early Hippocampal Damage.
Mishkin and colleagues (1998) have proposed that semantic memory can develop despite impaired episodic memory due to bilateral hippocampal damage early in childhood. The parahippocampal gyrus, thought to be intact in their series of children with early bilateral hippocampal damage, is hypothesized to be capable of rudimentary forms of declarative memory, such as recognition memory, by which semantic memory can be consolidated in the absence of an episodic memory trace. Using similar MRI volumetric methods as those employed by Mishkin et al. (1998), we identified 4 individuals with bilateral hippocampal volume loss occurring early in childhood, 2 of which also have bilateral volume loss of the parahippocampal gyrus. The degree of declarative memory deficits between these 2 pairs of individuals was not apparently different. There was no pattern evident to suggest that subjects with hippocampal damage alone had intact recognition memory or more enriched acquired semantic store when compared to the subjects with both hippocampal and parahippocampal damage. The findings are discussed in terms of the role of mechanism of hippocampal damage in childhood and declarative memory deficits, as well as the potential role of the parahippocampal gyrus in declarative memory.
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Paper Session 2/4:30–6:15 p.m.

BRAIN MAPPING

B. MEHTA, D. WILSON, J. XIANG, M. NOSEWORTHY, & R. SCHACHAR. MEG and Inhibitory Control: Identifying Neural Correlates of Cognition.
Inhibitory control is an important aspect of executive function. It comes into play when we attempt to withhold, alter, or stop an action or a thought and is implicated in development and psychopathology. We used magnetoencephalography (MEG) to study inhibition in a single normal right-handed volunteer (age 22) while performing the stop-signal paradigm. This task consisted of "go trials" without a stop signal and "stop trials" with a stop signal at some delay after the go stimulus. The subject was instructed to respond on go trials, but not to respond to the go stimulus if a stop signal appeared on the trial. A 151-channel whole-cortex MEG system was used to measure the brain magnetic field recordings while the subject performed the task on 2 separate occasions. Over 1000 trials were collected. In both sessions, a peak of magnetic activity, with a latency of 280–300 ms from the stop signal, was observed in all stop trials (successful and failed). However, a smaller peak occurring earlier was observed only in the successful stop trials. In the first session, this activity was observed at 245 ms after the stop signal. In the second session, the activity was observed at 225 ms, corresponding to better inhibitory control. This smaller peak was localized to the right frontal cortex by contour map and average-waveform analyses. Neural activity in this latency range (190–230 ms) has been attributed to an inhibition response in EEG recordings. The activity may represent the magnetic equivalent of the N200 wave as representative of an inhibitory response.
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D.B. WILSON, B. MEHTA, J. XIANG, M.D. NOSEWORTHY, & R. SCHACHAR. Spatiotemporal Mapping of Brain Activation Associated With Response Inhibition Errors.
Magnetoencephalography (MEG) was used to document and assess the spatiotemporal components of brain activation associated with stop task performance. A 151-channel whole cortex MEG was employed to record evoked magnetic fields during performance of the stop task. This task consisted of "go trials" without stop signals and "stop trials" with a stop signal at some delay after the go stimulus. Evoked magnetic field data were acquired throughout 16 blocks of stop task performance (32 trials/block) by a normal, healthy volunteer during each of 2 separate sessions. Comparison of averaged waveform data for go trials, failed stop trials (errors), and successful stop trials, time-locked to the response, identified a peak with a latency of about 300 ms (M300) in the failed stop trials (220–375 ms range). The peak was evident only in failed stop trials. These data suggest that the M300 may be associated with error detection and processing. Analysis of the raw data plot, contour map, and averaged waveforms of separate MEG channel groups localized the source of the M300 to the right medial frontal cortex. This spatial localization is consistent with ERP and FMRI studies of error-associated brain activation during response inhibition tasks. The error-associated M300 may be the MEG equivalent of the ERN (error-related negativity) observed in ERP studies. Functional MRI studies to more precisely localize the neuroanatomical correlates of stop task performance parameters, and MEG studies to evaluate the reliability and validity of the M300 as representative of brain activation associated with error detection, are ongoing in our laboratory.
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C. WHATMOUGH, H. CHERTKOW, L. VERRET, D. FUNG, K. HANRATTY, & V. WHITEHEAD. Increased Efficiency in the Lateral Inferior Temporal Cortex With Semantic Task Repetition: An ^{15}O PET Study of rCBF Changes Associated With Cognitive Task Priming.
Several studies have reported specific decreases in rCBF when stimuli are repeated across blocks of trials. Here we report changes associated with the repetition of semantic tasks in which stimuli are not repeated. In an ^{15}O PET study of semantic processing, elderly subjects were presented with 2 pairs of words (e.g., error–mistake, error–fright) and were asked to read out the pair of words that were similar in meaning. There were 4 blocks (i.e., scans) of trials 10 min apart with no repetition of stimuli across scans. Subjects' mean RT decreased significantly from the first to the second block, without further decreases on the third and fourth blocks. Analyses which correlated rCBF with scan order revealed that CBF decreased across scans in the left mid-posterior temporal area (centered at: −48, −30, −21). Previous analyses had associated this temporal area with more difficult semantic processing independent of scan order. Positive increases in rCBF across scans include: the medial frontal cortex and the right precentral gyrus. Areas shown to be critically involved in the task but which displayed no systematic change in CBF with scan order include the insula, the anterior cingulate, and the left middle frontal gyrus. Similar analyses of a PET picture naming study reveal that these findings generalize to other semantic tasks. These results indicate that areas of the temporal cortex involved in semantic processing become more efficient with repeated activation even when stimuli are not repeated.
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L.C. BAXTER, L.S. WILDER, D. J. CONNOR, M.N. SABBAGH, R. J. CASELLI, & S.C. JOHNSON. Hippocampal Adaptation to Repeating Stimuli: An FMRI Study of Encoding in the Elderly.
Impaired memory encoding is an early symptom of Alzheimer's disease (AD). Evaluating the functional integrity of the hippocampus, critical for encoding new memories, may help with early detection and treatment. We examined the dynamic process of encoding using fMRI under the assump-

tion that normal encoding may result in neuronal adaptation in response to repeated stimuli presentations. We hypothesized that adaptation would occur in the hippocampus and that better encoding ability would correlate with stronger hippocampal adaptation in elderly participants. *Methods:* Participants: 17 right-handed, healthy volunteers: mean age = 77.6, *SD* = 6.4; mean MMSE 27.5, *SD* = 1.1. Total word acquisition on the California Verbal Learning Test–II was used to estimate encoding (mean = 42.3, *SD* = 12.26). The fMRI task assessed adaptation to new repeating stimuli; participants viewed 4 faces, repeating 7 times (25 second repeat interval; 6.7 second average ISI, scan time 3′12″) for each of the 3 runs (different sets of faces). Images were processed using SPM99. Adaptation was modeled using Activation × Presentation interaction reflecting a negative (adaptation) slope followed by a Random Effects analysis of adaptation slope with CVLT entered as a covariate. *Results:* Adaptation slopes in the hippocampus (bilaterally) correlated with the CVLT (right: Talairach coordinates (x,y,z) 30, −18, −20; left: Talairach coordinates −24, −22, −18). *Conclusion:* Dynamic change in the hippocampus was associated with better learning ability on the CVLT. Slightly greater right adaptation may reflect greater adaptation to novel events. Longitudinal study of change in adaptation may help in early detection of prodromal AD.
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E. CASTILLO, R. DAVIS, P. SIMOS, J. BREIER, M. FITZGERALD, H. ISHIBASHI, W. ZHANG, & A. PAPANICOLAOU. Two Brain Mechanisms Mediating Different Levels of Word Processing and Memory Performance.
Events are more likely to be remembered when they are processed deeply. Accordingly, word recall is facilitated when deep (e.g., semantic) processing is applied during encoding. This fact raises the question of the existence of specific brain mechanisms that support different levels of information processing, which can modulate incidental memory performance. In this study, we obtained spatiotemporal brain activation profiles, using Magnetic Source Imaging, from 10 adult volunteers as they performed a shallow (phonological) processing task and a deep (semantic) processing task. When phonological analysis of the word stimuli was required, activation was largely restricted to the posterior portion of the left superior temporal gyrus (area 22). Conversely, when access to lexical/semantic representations was required, activation was found predominantly in the left middle temporal gyrus and medial temporal cortex. The engagement of each mechanism during word encoding was associated with dramatic changes in subsequent incidental memory performance. In conclusion, different levels of processing during word encoding are supported by dissociable brain mechanisms that either facilitate or minimize the incidental recall of these words. These findings constitute the first physiological evidence of 2 brain mechanisms that support different levels of linguistic processing in determining the ability to learn and retrieve verbal information.
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C. LEVERONI, K. DOUVILLE, M. SEIDENBERG, J.L. WOODARD, S.K. MILLER, K. NIELSEN, & S.M. RAO. Age-Related Changes in Neural Activation Associated with Famous Name Recognition: An fMRI Study.
We examined the neural activation associated with famous name recognition in 15 young (19–28) and 9 elderly (64–79) healthy subjects using fMRI. Subjects viewed 120 names which consisted of (1) names of individuals who were well-known in the 1950's but not today (FI); (2) individuals who became famous in the 1950's and have maintained their fame (EN); (3) individuals who entered the public domain in the 1990's (NI); and (4) unfamiliar names (FO). Younger subjects performed significantly worse than older subjects in the FI condition (13% *vs.* 85%) and EN condition (84% *vs.* 98%). No differences were observed for the NI and FO conditions. Regardless of condition, familiar name recognition induced a common pattern of neural activation that included bilateral anterior and medial temporal lobes, posterior parietal cortex, posterior cingulate cortex, and prefrontal regions. In addition, the functional maps showed greater activation of this network for older than younger subjects in all 3 recognition conditions. Moreover, in older subjects, a temporal gradient in neural activity was noted such that recently acquired names (NI) induced greater activation in the posterior cingulate, left dorsolateral prefrontal cortex, left parietal cortex, and thalamus than remotely learned names (EN and FI). The functional maps for EN and FI were similar. These results suggest (1) greater neural activation is associated with aging; and (2) the recognition of recently acquired memories requires greater input from frontal and parietal strategic retrieval processes than remote memories.
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K. DOUVILLE, C. LEVERONI, M. SEIDENBERG, J.L. WOODARD, S.K. MILLER, K. NIELSEN, & S.M. RAO. Activation of Person-Identity Networks with Famous Names: An fMRI Study.
In a previous fMRI investigation, Leveroni et al. (2000) examined the activation patterns associated with the recognition of famous faces compared to newly learned faces in 11 young healthy subjects. The current fMRI study investigated whether famous name recognition involved the same neural systems. Subjects were 15 neurologically healthy subjects, ages 19–28. For the activation task, subjects viewed 120 names which consisted of (1) names of individuals who were well-known in the 1950's but not today; (2) individuals who became famous in the 1950s and have maintained their fame; (3) famous individuals who entered the public domain in the 1990s; and (4) unfamiliar names. They identified the familiar names with a two-button keypress. Consistent with our previous face recognition study, famous names activated an extensive network of brain regions when compared to unfamiliar names, including the bilateral frontal lobe, bilateral anterior temporal lobes, bilateral mesial temporal lobe (hippocampal and parahippocampal regions), right inferior parietal lobe, and posterior cingulate cortex. The observation of common pattern of functional activity with famous face and name recognition suggests that these brain regions are associated with activation of underlying semantic networks associated with the person identity system (e.g., Bruce and Young, 1986). The present finding also supports current theories which posit that name generation is the final step in the retrieval of person-identity information.
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Symposium 1/4:30–6:15 p.m.

USING DEVELOPMENTAL NEUROSCIENCE APPROACHES TO UNDERSTAND PRESCHOOL EXECUTIVE FUNCTIONS

Organizer & Chair: Kimberly Andrews Espy

K. ESPY. Using Developmental Neuroscience Approaches to Understand Preschool Executive Functions.
Historically, investigators have believed that young children do not possess executive functions based on naturalistic observations of dysregulated and impulsive behavior. Contributing to this belief was the lack of adequate measures to capture executive skills in children under 6 years. Using tasks adapted from animal neuroscience and developmental literature, several laboratories have demonstrated that even young children are able to maintain information over delays for subsequent use, inhibit pre-

potent responding, flexibily shift among response sets, and to solve relatively complex problems. The purpose of the symposium is to present results using such approaches, to understand normal development and deviations from expectations in preschool children with differing disorders. Espy, Senn, and Kaufmann will present their findings regarding the organization of executive function components in typically developing preschool children. Gioia, Espy, and Isquith will discuss a different approach to executive function measurement, that is, using a new questionnaire to capture every day executive behavior. Canfield will describe the effects of low-level environmental lead exposure on preschool executive functioning, whereas Ewing-Cobbs, Prasad, Landry, and Kramer will present their findings in preschoolers with traumatic brain injuries. The nature of executive impairments after early damage to the frontal lobe are discussed by Smidts and Anderson. Espy, Stalets, Cwik, and Mitchell will present preliminary findings in young children born prematurely. Finally, Ris, Mitchell, Kalinyak, and Mansour will describe how these approaches are used to understand outcome in youngsters with sickle cell anemia. Yeates will discuss the broader implications and utility of this approach in pediatric neuropsychology.

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K. ESPY, T. SENN, & P. KAUFMANN. Executive Function Organization in Normally Developing Preschoolers.

There remains considerable debate concerning the precise nature of executive function. More cognitive approaches often focus on working memory and inhibition, whereas clinical neurological approaches view flexibility, problem solving, and social decision-making as critical executive components. Recently, researchers have viewed these diverse skills as executive function components, and then, have attempted to understand the relations among these executive processes using structural equation modeling procedures with adult subjects. A different way to investigate this issue is to study executive organization in young children as these skills emerge. As the structure and function of the prefrontal cortex undergoes significant synaptogenesis and myelination in young children, these brain changes may underlie differential organization of executive component processes in preschoolers, relative to older children and adults. Therefore, an executive function battery that included A-not-B, Delayed Alternation, Shape School (Inhibition Condition), Color Reversal, and Tower of Hanoi was administered to 69 children between 33 and 66 months of age. Structural equation modeling was used to test different patterns of relations among problem solving, working memory, inhibition, and set shifting/flexibility components. The best fitting model included direct paths from working memory, inhibition, and set shifting to problem solving, with the relations among working memory and inhibition to problem solving mediated through relations with flexibility. These results suggest somewhat different relations among executive components in young children and are discussed in light of neural organization of prefrontal circuits.

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G. GIOIA, K. ESPY, & P. ISQUITH. Executive Function in Preschool Children: Examination Through Everyday Behavior.

Executive functioning in children is characterized by development of regulatory control over behavior, thought, and problem-solving. The developmental trajectory of the executive function is hypothesized to be associated with the protracted development of the underlying neural substrate, i.e., the prefrontal systems and their broad interconnections. Recent examination has been conducted in preschoolers via a variety of performance tests (Espy, 2001). The present paper examines executive functions in preschool children *via* standardized parent and teacher ratings, using the Behavior Rating Inventory of Executive Function–Preschool version (BRIEF–P). Parent and teacher forms of the BRIEF (Gioia et al., 2000) were adapted to be developmentally appropriate for preschool behavior and administered to a normative sample ranging from 2 to 5 years of age. Whereas 3 scales associated with Behavioral Regulation emerged (Inhibit, Shift, Emotional Control), only 2 scales associated with the Metacognition were found (Working Memory, Organization). The emergence of the Behavioral Regulation scales in a preschool sample is neuropsychologically consistent with brain and behavior changes during the preschool period. Functional specificity and continuity with school-age behavior regulation is suggested. In contrast, the metacognition scales are more neuropsychologically global and less differentiated at this early stage. Developmental and gender differences revealed particular difficulties for 3-year-old boys; girls' functioning remained relatively stable over the 2 to 5 year age range. These findings have implications for the neurodevelopmental trajectory of an emerging array of functions associated with orbital-medial and dorsolateral frontal systems. Developmental and clinical neuropsychological applications are discussed.

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R.L. CANFIELD. Low-Level Lead Exposure and Executive Functions in Young Children.

Experimental studies of nonhuman primates and neuropsychological test performance in adolescents and older children suggest that lead exposure impairs prefrontal functioning, possibly through lead's effects on the mesocortical dopamine system. This paper presents new data on executive functions in lead-exposed preschoolers from a longitudinal study of 200 children with low blood lead levels (BLLs; peak BLL at 2 years = 9.5 μg/dL). Children were tested at 48 and 54 months of age using 2 tests of executive functioning: Delayed Spatial Alternation (DSA), and The Shape School (SS). On both tests, children with higher concurrent or early BLLs performed more poorly. On the DSA test children with higher BLLs were less likely to choose the correct side and made more perseverative (lose-stay) errors. On the SS test children had difficulty with even the easiest of the 4 conditions in which they must identify red, blue, and yellow cartoon characters by saying their color name. Children with higher BBLs took significantly longer to carry out these simple actions. It is suggested that in this population the SS task required children to perform relatively novel mental and motor actions in a temporally and spatially organized manner. For both tasks, significant associations with BLL remained after controlling for a broad range of possible confounders, including maternal IQ, education, income, HOME score, birth weight, preterm status, iron status, birth order and, in many cases, after controlling for the child's own Stanford-Binet IQ.

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L. EWING-COBBS, M. PRASAD, S. LANDRY, & L. KRAMER. Executive Functions Following Traumatic Brain Injury in Young Children: A Pilot Study.

Despite the importance of executive function deficits following traumatic brain injury (TBI), these functions have not been studied in young children. We piloted several tasks purported to assess aspects of executive functions that were adapted from developmental neuroscience studies of animals. The Delayed Response, Spatial Reversal, and Multiple Boxes tasks were administered to assess working memory, inhibition, set shifting, and perseverative responding. Performance was assessed in 17 children at least 1 year following moderate to severe TBI and in 22 comparison children. All children were 14–65 months of age at the time of testing. On the Delayed Response task, the TBI group showed impairment finding an object hidden under 1 of 2 cups according to a predetermined schedule following a 5-sec delay. The Spatial Reversal task required shifting response set and searching for a hidden object that was moved after 4 consecutive correct searches in the same location. This task did not yield group differences on indices of total correct searches, perseverative responses, or failure to maintain set. For the Multiple Boxes task, children searched for rewards in boxes placed in a stationary array. A 5-sec delay

occurred between trials. TBI children tended to have less efficient search strategies and required more searches per box than comparison children. Across all tasks, performance improved and errors decreased significantly with age. Relative to comparison children, young children with TBI showed difficulty on tasks that required holding information in working memory. Correspondence: *Linda Ewing-Cobbs, University of Texas Health Science Center at Houston, 7000 Fannin, Suite 2431, Houston, TX 77030. Linda.Ewing-Cobbs@uth.Tmc.edu*

D. SMIDTS & V. ANDERSON. The Impact of Early Frontal Lobe Damage on the Development of Executive Functions.
This presentation will describe preliminary findings of a study currently in progress at the Royal Children's Hospital and the University of Melbourne. The aims of this project were to investigate the normal development of executive functions in children between 3 and 7 years old and to examine the impact of early frontal lobe damage on the development of these skills. Aspects of executive functions studied included: inhibition, working memory, cognitive self-regulation, planning, organization, and selective attention. These abilities were assessed by using a developmental neuropsychological assessment (NEPSY; Korkman, Kirk, & Kemp, 1998), the Shape School (Espy, 1997), a Stroop-like day-night test (Gerstadt, Hong, & Diamond, 1994), the Behavior Rating Inventory of Executive Functions (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), and the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992). A new test, the Object Classification Task for Children (OCTC), was used to measure concept generation and cognitive flexibility. On this task, children had to sort 6 toys according to 3 dimensions (color, size, and function). The task has 3 levels of difficulty with increasing structure to allow for greater fractionation of the underlying processes contributing to sorting behavior in children. Preliminary results indicate that children with frontal brain damage perform more poorly on executive function measures, when compared to healthy children of the same age. Results are discussed in terms of the development of executive functions. Correspondence: *Diana Smidts, Department of Psychology, School of Behavioural Science, Redmond Barry Building, The University of Melbourne, Melbourne, Victoria 3010, Australia. d.smidts@pgrad.unimelb.edu.au*

K. ESPY, M. STALETS, M. CWIK, & D. MITCHELL. Prematurity and Executive Functions in Preschoolers.
Children born prematurely are at risk for a host of neurocognitive impairments that range in severity from mental retardation and cerebral palsy to learning and attention disorders. In those with low severity disorders, often there is no evidence of frank brain damage using various neuroimaging techniques. Clearly, there is a brain basis for these disorders, as the skill deficit patterns are consistent across children born preterm, with visual motor, spatial, attention, arithmetic, and nonverbal executive functions affected most often. Recently, executive function deficits in school age children born preterm have been identified, but this issue has not been investigated in preschoolers. Therefore, tasks adapted from developmental neuroscience paradigms were utilized to better understand early executive functions in young children born preterm. In a sample of 2- and 3-year-olds born preterm (*M* birth gestational age = 30.2 weeks) and full-term controls matched in age, sex, race, and maternal education, a nonverbal executive function battery was administered. Working memory was measured by Delayed Response and Delayed Alternation tasks, Flexibility skills by Spatial Reversal, and Maintaining a Rule in light of distraction was assessed by Spatial Reversal with Irrelevant Cues. Preschool children born preterm scored lower than matched controls on both working memory tasks and had more difficulty maintaining the retrieval rule in light of distraction. Flexibility skills, however, were comparable among young children. These preliminary findings are discussed in light of the effects of premature birth on early neural organization and the developmental vulnerability of subcortical structures involved in prefrontal function. Correspondence: *Kimberly Espy, Department of Psychiatry, MC 6503, Southern Illinois University School of Medicine, Carbondale, IL 62901-6503. kespy@siumed.edu*

M.D. RIS, M. MITCHELL, K. KALINYAK, & M. MANSOUR. Early Development of Children with Sickle Cell Anemia (SCA).
It is well-documented that children with sickle cell disease, particularly those with the SS genotype, are at risk for neurodevelopmental problems. Recent studies have demonstrated that risk is greatest in children with clinical strokes and those with MRI evidence of "silent strokes." Anterior regions of the brain, in particular, have been implicated by cerebral blood flow and perfusion studies. Typically, samples of older children have been studied neuropsychologically, although there is mounting evidence that neuropsychological changes begin early in life. We recently embarked on a prospective, longitudinal study of children with SCA in which we are tracking, from 6 months of age, various biologic/medical variables. Beginning at 12 months of age, subjects undergo annual neuropsychological evaluations emphasizing frontal-executive functions including those standardized by Espy and Gioia's BRIEF–P. Starting at age 3 years, transcranial doppler (TCD) exams will be performed every 6 months to screen the patency of the major intracranial arteries. Abnormal TCD studies will be followed by imaging (MRI/MRA). Since developmental outcome is multidetermined, assessments of family functioning/composition, socioeconomic status, parental stress, and parent IQ are also undertaken. Our preliminary data are consistent with average neurodevelopmental performance, and more variable performance on executive function tasks.
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Symposium 2/4:30–6:15 p.m.

THE BASAL GANGLIA: INTERFACE BETWEEN COGNITION AND ACTION

Organizer & Chair: Julie C. Stout

J.C. STOUT. The Basal Ganglia: Interface Between Cognition and Action.
One emerging challenge for clinical neuroscience has been the development of models to explain the comorbidity of cognitive and motor changes following disruptions of basal ganglia function. The convergence of recent neuroanatomical and cellular recording studies have supported the view that the basal ganglia serve as an interface between cognition and action by providing a final pathway for response selection. For the first talk of this symposium, Jonathan Mink will present a model of response selection processes implemented by the basal ganglia and emphasize the role of inhibition of competing actions. Kathleen Haaland, Vincent Filoteo, and Scott Wylie will describe response selection models from cognitive psychology that have been applied in studies of HD and PD. The speakers will relate findings from these studies to clinical measures of disease severity. This symposium will build the conceptual basis for understanding how some of the comorbid cognitive and motor changes that occur following damage to basal ganglia function may be accounted for by alterations in response selection.
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J. MINK. Basal Ganglia Selection and Inhibition of Competing Behavior.
It is well-known that neurodegenerative diseases of the basal ganglia are associated with rigidity, bradykinesia, and involuntary movements. However, the precise contribution of the basal ganglia in the diverse symptom presentation of the movement disorders has been slow to unfold. In the past decade, anatomical and neurophysiological studies have revealed that the basal ganglia have an important role in effective movement by interacting with competing motor programs to inhibit their influence on motor outputs. At the same time, the basal ganglia can reduce inhibitory influ-

ences that affect desired responses. In effect, this filtering role of the basal ganglia allows precision in behavior by increasing the selectivity with which motor responses can be realized. Thus, damage to the basal ganglia interferes with normal motor and other behavioral output reducing the selectivity of competing responses, and leads to observations such as slowing, involuntary movement, and even declines in cognitive function in basal ganglia disease.
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K.Y. HAALAND. Can Response Inhibition Do It All?
The complex neuroanatomy of the corticostriate system has influenced speculation about its underlying cognitive properties and how they influence action. Many cognitive explanations for these deficits have been suggested, and this presentation will review several of those explanations in the context of motor sequencing and motor learning. While a model that emphasizes the basal ganglia's role in inhibiting competing responses is compelling, this presentation will review other explanations, such as impaired development and implementation of motor programs, to determine if other models should be considered.
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J.V. FILOTEO. Selection for Action in Patients with Parkinson's Disease.
Although it has been well established that even nondemented patients with Parkinson's disease (PD) can display impairment on a variety of attentional measures, the mechanism of such impairment has remained elusive. Recent behavioral data has indicated that patients with PD can display deficits on tasks known to require inhibitory attentional processes, including tests of selective attention and orienting of attention, suggesting that the basal ganglia (the brain regions affected in PD) are involved in inhibitory processes. In this symposium, studies from our laboratory will be presented that suggest that the locus of the inhibitory attentional deficits in PD patients is at the response selection stage of processing. Further, the argument will be made that role of the basal ganglia on certain attentional tasks is to inhibit inappropriate responses so that an appropriate response can be selected. This proposed role of the basal ganglia in response selection is supported by the known architecture of these structures, which allows for both an amplification and inhibition of incoming, competing signals. Overall, it is argued that at least one of the neurocognitive roles of the basal ganglia is to serve as an interface between cognition and action.
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S.A. WYLIE. Altered Response Selection in Parkinson's Disease and Huntington's Disease.
The basal ganglia are a group of subcortical nuclei whose role in movement and cognition has received considerable attention in recent years. Clinical interest in diseases that disrupt normal basal ganglia activity along with advances in basal ganglia neuroscience have fueled this interest. A leading model of basal ganglia function proposes that these structures represent an interface between cognition and action that facilitates efficient response selection. This model implies that some of the neuropsychological changes that occur following disruption to basal ganglia activity may be understood in terms of altered response selection processes. Several response time effects, including negative priming, flanker, and stimulus-response compatibility effects, have been extensively studied in cognitive psychology to draw inferences about the cognitive processes that mediate response selection. This talk will review findings from our laboratory that describe alterations in these effects and their relationship to clinical measures in Parkinson's disease and Huntington's disease. These findings highlight the importance of research to integrate models and methods from neuroscience, cognitive psychology, and clinical neuropsychology.
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Thursday Morning, February 14, 2002

Poster Session 2/8:00 a.m.–12:45 p.m.

TRAUMATIC BRAIN INJURY

S. GRIFFIN, E. ELBOGEN, & W. SPAULDING. Prediction of Vocational Functioning Following Severe TBI.
The present study investigated the relationship between neuropsychological functioning and vocational performance, as assessed by supervisor ratings on the Work Personality Profile (WPP; Bolton & Roessler, 1986) and the Becker Work Adjustment Profile (BWAP; Becker, 1989), in a sheltered workshop setting. Twenty-five individuals with a history of severe traumatic brain injury (TBI) completed a comprehensive neuropsychological battery. Scores were theoretically and statistically combined to create 10 cognitive composites (i.e., verbal and visual attention, speed of information processing, verbal and visual memory, language, visuospatial, abstraction, arithmetic, and motor). WPP and BWAP scores were theoretically and statistically combined to create 5 vocational composites (i.e., overall vocational functioning, attitude toward work role, interpersonal relations, supervision needs, and ability to complete task demands). None of the cognitive composite scores produced significant univariate correlations with any of the vocational composites. Examination of individual neuropsychological measures revealed that only Trails B correlated with overall vocational functioning ($r = -.67$). Among noncognitive predictors of vocational performance, premorbid occupational level was correlated with overall vocational functioning, interpersonal relations, and supervision needs (r's = .48, .40, and .46, respectively) and length of loss of consciousness was correlated with attitude toward work role ($r = -.62$). Results suggest that, in a severely impaired, sheltered workshop TBI sample, neuropsychological measures are of limited utility in predicting vocational performance. Future studies investigating prediction of specific aspects of vocational performance (as opposed to dichotomous outcome variables such as return to work) in less impaired TBI populations are greatly needed.
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S. GRIFFIN, E. ELBOGEN, & W. SPAULDING. Neuropsychological Prediction of Activities of Daily Living Following Severe TBI.
The relationship between neuropsychological functioning and activities of daily living (ADL), as assessed by 2 performance-based measures: Direct Assessment of Functional Status (DAFS; Loewenstein et al., 1989) and Independent Living Scales (ILS; Loeb, 1996). Twenty-five individuals with a history of severe traumatic brain injury (TBI) were administered a comprehensive neuropsychological battery. Scores were theoretically and statistically combined to create 10 cognitive composites [i.e., verbal and visual attention, speed of information processing (SOIP), verbal and visual memory, language, visuospatial, abstraction, arithmetic, and motor]. DAFS and ILS scores were theoretically and statistically combined to create 5 ADL composites (i.e., overall daily living skills, everyday problem-solving, health, money management, and utilization of community resources). Arithmetic performance obtained the highest univariate corre-

lation with all 5 ADL composites, accounting for 32%–41% of the variance in these domains; arithmetic was the only cognitive composite to enter stepwise multiple regression analyses predicting everyday problem-solving, health, money management, and utilization of community resources. In addition to arithmetic, SOIP contributed to the prediction of overall daily living skills (R^2 for full model = .45). Neuropsychological performance accounted for greater variance in ADLs than other potential predictors of outcome following TBI (i.e., demographic variables, severity of injury variables, and emotional functioning). While no studies to date have investigated arithmetic ability in prediction of ADLs following TBI, tests of arithmetic might be tapping premorbid abilities which relate to post-injury daily living skills. Further studies investigating the relationships between premorbid achievement/functioning and post-injury ADLs are warranted.

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C. BURTON, E. STRAUSS, D. HULTSCH, & M. HUNTER. Intraindividual Variability in TBI: Physical and Emotional Functioning.

Recent research has shown that individuals with certain neurological conditions, such as traumatic brain injuries and Alzheimer's disease, demonstrate greater intraindividual variability on cognitive tasks compared to healthy controls. The present study sought to extend these findings by investigating intraindividual variability in the domains of physical functioning and affect/stress in 3 groups: adults with mild head injuries, adults with moderate/severe head injuries, and healthy adults. Following an intake session, participants were assessed on 10 separate occasions. Results indicated that (1) individuals with moderate/severe head injuries demonstrated greater variability than the healthy adults on a measure of finger dexterity; (2) in general, poorer physical functioning was associated with increased inconsistency in physical function across a wide array of tasks; and (3) psychological distress is linked, to a somewhat lesser extent, with increased physical variability. The findings suggest that increased variability in physical function, as well as cognitive function, represents an indicator of risk.

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M. GAROLERA, E. HUGUÉ, & M. AGUILAR. Improvement in Executive Functions in Traumatic Brain Injury After Donepezil Treatment.

Cholinesterase inhibitors improve cognitive functions, particularly memory impairment in Alzheimer's disease. This treatment is being extended to some patients suffering from traumatic brain injury (TBI). We present a patient who was involved in a traffic accident at the age of 15. The GCS (Glasgow Coma Scale) at admission was 8 and cranial CT showed a massive subarachnoid hemorrhage at basal cisterns. While in hospital, a lobar hematoma appeared on the left frontal area which required craniotomy drainage; later on, hydrocephalus appeared. The latest cranial CT, done 3 years after the accident, shows bifrontal hipodensity, mainly left. Due to a severe long-term memory and learning abilities impairment, we decided to treat him with donepezil for 9 weeks, with 5 mg/day during the first 5 days and 10 mg/day for 28 days. A neuropsychological examination was performed before and after the treatment. We used the following neuropsychological battery: WAIS–III, Finger Tapping, CVLT, WMS–III, verbal fluency, Stroop, WCST, and Tower of London. A statistically significant improvement (>1 *SD*) was observed in executive functions such as abstraction capacity, analytic reasoning, cognitive flexibility, initiative, and organization of the action with the results of a greater immediate memory capacity. These results show that, while there is no change in consolidation memory, executive functions improved with donepezil administration, opening a new field of research: treatment of young TBI with different localization than the temporal medial lobe.

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A. BLODGETT & A. TELLIER. Insight and TBI: The Biasing Impact of Depressed Mood on Subjective Ratings.

Impaired insight, a common sequela of traumatic brain injury (TBI), has traditionally been defined as the difference between a TBI patient's subjective rating and that of a significant other. The practice of using the significant others as the "gold standard," however, fails to recognize the possibility that their reports might be biased by depressed mood. The purpose of this study was to investigate the impact of depressed mood on the subjective memory ratings of TBI patients and their significant others, a concept that has been largely ignored to date. The sample consisted of 19 TBI patients, 19 age- and education-matched community controls, and the nominated significant others of each group ($n = 38$). The objective memory performance of TBI and community control participants was assessed using the Wechsler Memory Scale–III, subjective memory ratings were obtained using the Subjective Memory Questionnaire, and depressed mood was assessed with the Beck Depression Inventory. Standard linear regression analyses failed to reveal a significant contribution of either depression or objective memory performance to the subjective memory ratings of the TBI patients or their significant others ($p = .10$–$.13$) or of the significant others of the community controls ($p = .16$). In contrast, depression did significantly impact ($r = -.56$; $p = .004$) the subjective ratings of community controls, whereas their actual memory performance bore little relationship to their subjective ratings. The present findings highlight the variable impact of depression on subjective ratings and bring up interesting issues with respect to the imperfect relationship between subjective self-reports and objective memory performances.

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J. HASEGAWA, T. KOGURE, & T. HATTA. A Study of Executive Dysfunction in Patient with Traumatic Brain Injury.

This research investigated whether mild traumatic brain injury (TBI) patients are impaired on a task that involves executive function. Twenty-two TBI patients, their mean full IQ was 80.86 (WAIS–R), and 25 normal participants performed tasks requiring working memory. The task employed consisted of 3 conditions (articulate inhibition, spatial inhibition, and control condition). Four letters were randomly presented in 4×4 matrix on the computer screen. The task required participants to recall their letters and their locations. In articulate inhibition, participants were asked to repeat 4 digit numbers, and in the spatial condition, participants were asked to trace dots that were presented randomly for 7 seconds. In the control condition, they did nothing for 7 seconds. The results revealed that in both inhibition conditions, the correct recall rates of the TBI group were higher than that of the normal group, whereas there was no difference between the TBI group and normal group in the control condition. Furthermore, to examine perseverative responses in TBI, repeated intrusion errors were calculated. The TBI group made significantly more errors than the normal group in all conditions. These phenomena would reflect one aspect of executive dysfunction of the TBI group. The results are discussed in relation to the working model.

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K.A. WISEMAN, D. J. LaPORTE, G. RATCLIFF, S. CHASE, & A. COLANTONIO. Predicting Very Long-Term Cognitive and Functional Outcomes of Traumatic Brain Injury.

This study examined the extent to which the Rivermead Behavioural Memory Test (RBMT), a psychometric measure constructed to reflect the memory demands of daily life, can predict very long-term functioning following TBI. Using a retrospective cohort design, 87 rehabilitation patients who had sustained moderate to severe TBI were re-evaluated an average of 10 years post-injury. All patients in the current study had been administered the RBMT during the post-acute period of recovery. Follow-up evaluations consisted of psychometric and self- and informant-report functional measures. Hierarchical regression analyses were used to evaluate the pre-

dictive ability of RBMT. In each analysis, patient age at injury, injury severity, and time to follow-up were entered into the regression equation first. Hierarchical regression revealed that baseline RBMT was predictive of long-term performance on psychometric measures [$F(1,70) = 18.90$, $p < .001$], and informant reports of patient cognitive [$F(1,66) = 10.89$, $p < .01$] and physical [$F(1,66) = 7.53$, $p < .01$] functioning at follow-up. RBMT accounted for 19.8% of the variance in psychometric outcome, 13.0% of variance in cognitive functioning, and 9.4% of variance in physical functioning after controlling for age, severity of injury, and time to follow-up. A separate hierarchical regression revealed that specific informant reports of patient memory impairment at follow-up were predicted by baseline RBMT data [$F(1,66) = 7.70$, $p < .01$]. Baseline RBMT data accounted for an additional 9.6% of variance in outcome after controlling for age, severity, and time to follow-up. These findings lend support to the RBMT's utility in predicting very long-term outcomes for TBI patients.
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N. PASTOREK, H. HANNAY, & C. CONTANT. Outcome Prediction From Acute and Serial Testing Following Closed Head Injury.
In order to achieve desirable test completion rates, assessment is typically conducted after a patient emerges from PTA. This practice can delay testing for severely injured patients, and the variable time delay between injury and testing can complicate the interpretation of research findings. Favorable completion rates for uniform assessment at 1-month post-injury have been attained with a short battery measuring language comprehension and attention (Hannay & Sherer, 1996). The ability of the attention and language comprehension measures to predict global outcome following head injury has not been determined. In the current study, the performance of 112 head injury survivors on this battery was used to determine the ability of these tests to predict global outcome at 6 months post-injury. It was hypothesized that 1-month performance on these measures would aid in the prediction of DRS scores collected at 6 months post injury. Further, the rate of change on these measures, determined by repeated evaluations at 3 and 6 months post-injury, was hypothesized to aid in the prediction of global outcome. Only measures of language comprehension significantly improved prediction of global outcome. Specifically, performance at 1-month post-injury, but not change in performance over time, on the Test of Complex Ideational Material accounted for variance in DRS scores above that accounted for by age, education, initial GCS, and pupil response. The reverse was true for the Mini Token Test. Administration of a battery 1-month following head injury is feasible and can aid in the prediction of global outcome.
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C.P. MILLIKIN, D. SHORE, B.P. ROURKE, J. FISK, & G. YOUNG. MCMI–II Psychopathology Subgroups in Traumatic Brain Injury.
Groups of individuals with traumatic brain injury (TBI) are heterogeneous with respect to type and severity of psychopathology. In the present study, cluster analysis was used to identify homogeneous psychopathology subgroups in a sample of 70 individuals with TBI who underwent medical-legal assessment. The majority of the sample had suffered mild TBI. Psychopathology was measured using the Millon Clinical Multiaxial Inventory–II (MCMI–II). Subgroups with significant psychopathology were expected to demonstrate poorer performance on neuropsychological tests. Subgroup differences in demographic and injury severity variables were also predicted. Base rate scores of selected MCMI–II scales were entered into multiple methods of hierarchical cluster analysis. Three psychopathology subgroups, labeled Normal, Generalized Distress, and Withdrawn, were identified. Age and education levels did not distinguish the subgroups. The Normal subgroup was predominantly female, while the Withdrawn subgroup was predominantly male. Length of posttraumatic amnesia (PTA) was comparable across all 3 subgroups. Within the Normal subgroup, length of PTA did not exceed 24 hrs. Patients in the Withdrawn subgroup demonstrated poorer general memory performance (WMS–R) compared to the other 2 subgroups. Otherwise, the subgroups did not differ with respect to neuropsychological test performance. Previous studies of TBI psychopathology subgroups have reported similar findings (i.e., few differences in injury severity and neuropsychological functioning). Future prospective studies should examine the development of psychopathology following TBI.
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T. VERAMONTI, H. J. HANNAY, N. PASTOREK, C. CONTANT, & C. ROBERTSON. Prediction of DRS Outcome Following TBI by Early Xenon-CT CBF Measurement.
Trauma-induced changes in cerebral blood flow (CBF) following TBI may result in an increased risk of further brain damage and worsening of clinical outcome. Numerous investigations have evaluated the significance of changes in CBF following TBI and the utility of CBF data in predicting outcome. These studies have demonstrated that CBF decreases to levels substantially below normal in the initial hours following TBI, and that by approximately 12 hours post-injury, CBF rises to levels that approach or exceed normal in the majority of patients. Moreover, reduced CBF in the early hours following TBI is strongly predictive of poor global outcome, as measured by the Glasgow Outcome Scale (GOS). To date, no studies have evaluated the association between early CBF and outcome, as measured by the Disability Rating Scale (DRS). The current study evaluated the relationship between average CBF and DRS outcome at discharge, 1, 3, and 6 months post-injury. Xenon-CT scan measurements were made in 55 severe TBI patients within 12 hours of injury. Age, GCS, and pupillary response were entered into a linear regression model and accounted for a significant proportion of the variance (24–30%) at all time points. Average CBF accounted for an additional 14–22% of the variance, depending on outcome time point. The nature of the injury (level of diffuse injury or presence of mass lesion) did not contribute to a significant proportion of the variance and was not included in the model. These findings highlight the importance of acute variables in predicting outcome following severe TBI.
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L.A. DADE, N. KOVACEVIC, C.M. O'TOOLE, F.Q. GAO, P. ROY, N. J. LOBAUGH, S.E. BLACK, & B. LEVINE. Quantification of Diffuse Axonal Injury in Traumatic Brain Injury Using Tissue Compartment Segmentation.
Diffuse axonal injury (DAI) is the predominant neuropathological consequence of traumatic brain injury (TBI), yet there are very few techniques available for its quantification. We have developed a MRI analysis protocol that provides rapid, reliable, and accurate quantification of tissue compartments based on analysis of voxel intensity. MRI's of 26 patients who had sustained a TBI approximately 1 year prior to scanning and 12 age-matched healthy controls were analyzed. Automated segmentation was carried out on the T1-weighted images (skull extracted) using 4 gaussian curves fit to a 2-dimensional histogram to model image intensity. The approach taken automatically compensates for inhomogeneity of intensity values across the T1 image. Volume measures of gray and white matter and CSF all reliably discriminated among groups. All TBI patients had significantly lower parenchymal volumes (measures corrected for head size) than control subjects, and severe TBI patients had significantly lower parenchymal volumes than mild TBI patients. Analysis of individual compartments supported previous research suggesting a greater effect of DAI on white matter as opposed to gray matter. Consistent with the known effects of DAI on speed and efficiency of mental operations, volumetric indices generated by this protocol were significantly and specifically related to speeded tests such as symbol-digit transcription ($r = -0.63$). Quantification of DAI in the chronic phase provides a more precise measure of TBI neuropathology than other widely used clinical methods, such

as relying on injury severity indicators or qualitative assessment of neuroimaging.

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T. ROEBUCK, T. ATCHISON, A. SANDER, M. STRUCHEN, & W. HIGH. Ability of Neuropsychological Tests to Predict Productivity: Risk and Protective Factors.

Many studies have examined the use of neuropsychological tests to predict future productivity for patients with traumatic brain injury (TBI). Yet, there is a sizable percentage of patients for whom the predictability of these tests is inaccurate. The current study used an existing database to explore differences in demographic, psychosocial, injury severity, and cognitive variables for TBI patients with well-predicted *versus* poorly predicted productivity status as determined by a battery of neuropsychological tests administered at 1 year post injury. Logistic regression (with age, education, and a battery of cognitive tests as predictors) was used to predict productivity status 2 years post injury in 117 patients with moderate to severe TBI. Seventy-seven percent of patients were correctly classified as either productive or not productive. No differences between age, race, medical complications, or drug use were found between predicted groups. Patients inaccurately predicted to be productive were more likely to have been unemployed at the time of injury, to have received free medical care, and to have attended special education classes. Patients correctly predicted to be productive were more likely to have been students preinjury and to have had private insurance. Patients inaccurately predicted to be nonproductive were less severely injured, were more likely to be productive at 1-year, required less supervision, and performed relatively better on measures of attention and processing speed than patients who were accurately predicted to be nonproductive. These data are exploratory in nature, although they suggest potential risk and protective factors that may aid in a clinician's ability to predict future productivity based on neuropsychological testing.

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A. SANDER, T. ATCHISON, W. HIGH, J. WEFEL, & C. CONTANT. Relationship Between Family Functioning and Outcome Following TBI.

The contribution of demographic and injury-related variables to outcome following traumatic brain injury (TBI) is well-documented. However, a percentage of the variance remains unaccounted for. Family functioning is a variable that has the potential to impact functional recovery. The current study investigated the relationship between family functioning and outcome between 1 and 5 years post-injury. Participants were 76 persons with moderate to severe TBI who were enrolled in a longitudinal study of outcome following TBI. Family functioning was assessed using the Family Assessment Device, Social Support Questionnaire, Ways of Coping Questionnaire, General Health Questionnaire, and Brooks Objective and Subjective Burden Scales. The outcome of the person with injury was assessed by the Disability Rating Scale (DRS; Total Score, Level of Functioning, and Employability items) and the Community Integration Questionnaire (CIQ; Home Competency, Social Integration, and Productive Activity Scales). Principle components analysis conducted on the family measures yielded 3 components. Regression of the 3 family components onto each outcome measure revealed that 1 component was related to outcome on all DRS scores and CIQ Total and Home Competency scores. Another component was related to CIQ Social Integration score. The component that contributed significantly in this initial model was subsequently added to a model including age and injury severity. Evaluation of the R^2 change revealed that the family component added significantly to the variance in DRS scores and to the CIQ Total and Home Competency scores. The results indicate the importance of including family functioning in models assessing predictors of outcome.

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T. ERGH, R. COLEMAN, L. RAPPORT, & R. HANKS. Predictors of Awareness of Deficit Among Patients with Traumatic Brain Injury.

Impaired awareness of deficit is observed frequently among patients who have sustained a traumatic brain injury (TBI). Impairments of this nature hinder the rehabilitation process and increase supervisory burden for caregivers. Predictors of awareness of deficit following moderate to severe TBI were assessed in a sample of 60 former patients and their caregivers. Time post injury ranged from 4 months to approximately 10 years (M = 4.8, SD = 2.6). The former patients and their caregivers were administered questionnaires examining the patients' functional abilities, as well as neurobehavioral and affective functioning. Patients also were administered 4 cognitive tests tapping executive functioning and information processing speed. Hierarchical multiple regression was conducted with awareness of deficit as the dependent variable, which was measured by the discrepancy between patient self-report and caregiver report on the Patient Competency Rating Scale (PCRS). After accounting for variance attributable to severity of injury as measured by the Disability Rating Scale (DRS) at discharge, neurobehavioral and affective functioning (NBAP), Matrix Reasoning (MR), Letter-Number Sequencing (LNS), Colored Trails 1 (CT1) and Colored Trails 2 (CT2) accounted for 38% of the variance in awareness of deficit. The full model accounted for 42% of the variance in patient awareness of deficit ($p < .001$). NBAP was the best predictor, accounting for up to 27% of unique variance, followed by DRS and LNS (both sr^2 = 4%), CT1 ($sr^2 = 2\%$), MR and CT2 ($sr^2 < 1\%$ each). These findings may have implications for interventions designed to enhance the quality of life for both patients and their caregivers.

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S. GEISLER, J. EVANS, L. TREXLER, & G. BOND. The Influence of Emotional Factors on the Measurement of Anosognosia.

The purpose of this study was to investigate the possible confounding influence of denial and depression on the assessment of anosognosia. Unawareness of deficits is a common phenomenon following brain injury and can be a function of either brain damage or psychological denial. In this study, the influences of denial and depression on Patient Competency Rating Scale (PCRS) scores were examined in a sample of brain injury and orthopedic injury patients. While patients with a brain injury overestimated their functioning, patients with an orthopedic injury underestimated their functioning even after controlling for denial and depression (p = .001). For both injury groups, higher scores of depression were associated with lower ratings of patient functioning by both patients and therapists. Denial was not associated with patient or therapist ratings in the brain injury group, but higher scores of denial were associated with higher patient ratings in the orthopedic group. A discrepancy score representing the difference between patient and therapist ratings on the PCRS was also positively correlated with denial for orthopedic patients. Multiple regression analyses indicate that depression was the only significant predictor of patient and therapist ratings of functioning. Results of this study show that while depression and denial influence both patient and therapist ratings of functioning, the PCRS is still a valid measure of anosognosia following brain damage in this sample.

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F. GOULD, C.D. MARKER, F.E. TABANICO, S.K. MILLER, E.S.W. DORSETT, L.R. COX, & J.L. WOODARD. Practice Effects and the Evaluation of Cognitive Performance in Sports-Related Concussion Research.

This study looked at the use of serial neuropsychological testing in the investigation of neuropsychological effects of sports-related head injuries. Participants included 73 varsity high school football players. All participants underwent baseline cognitive assessment, and 62 completed postseason evaluation. The cognitive battery consisted of the Hopkins Verbal Learning Test–Revised (HVLT–R), Digit Symbol-Coding (DSC) and Symbol Search (SS) subtests from the Wechsler Adult Intelligence Scale–III,

Controlled Oral Word Association test (COWA), the Brief Test of Attention (BTA), and a dual processing task that consisted of a symbol cancellation task and counting backwards. Seven concussed and 6 matched, nonconcussed control participants were additionally evaluated at 24–48 hours and 7 days postinjury. All groups showed improvement in postseason testing relative to baseline, across most tests. The players with greater testing exposure showed a significantly greater positive practice effect on HVLT–R delayed recall, DSC, SS, and both the cancellation and counting components of the dual processing task when compared to those players who were only evaluated twice. Practice effects were not evident on COWA, HVLT–R immediate recall, or BTA. Alternate forms did mitigate practice effects for some, but not all, measures. Quantification of the magnitude of time-related changes associated with serial testings would be helpful for unmasking the true cognitive performance of injured players that is independent of the effects of practice.

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J.L. WOODARD, E.S.W. DORSETT, F.E. TABANICO, C.D. MARKER, S.K. MILLER, L.R. COX, & F. GOULD. Base Rates and Stability of Postconcussive Symptoms in Varsity High School Football Players.

Physical and cognitive symptoms are commonly assessed following concussion. The majority of these symptoms are assumed to be associated with the effects of concussion, although many symptoms may be present in differing severities and degrees in the absence of concussion (e.g., at baseline). This study assessed the base rates of symptom presence and severity in a sample of 73 varsity high school football players. At baseline, the 6 most common symptoms included fatigue, taking longer to think, irritability, feeling frustrated or impatient, drowsiness, and restlessness, whereas the 5 least common symptoms included dizziness, vomiting, feeling as if in a fog, balance problems, and difficulty getting along with others. At postseason and 6 months following the end of the season, this pattern of symptom reporting was remarkably stable, although there was a slight, significant increase in number of symptoms reported at 6 month follow-up. Symptom severity ratings, but not number of symptoms endorsed, correlated significantly with delayed recall from the Hopkins Verbal Learning Test–Revised at both baseline and postseason. Principal components analysis of symptom responses revealed a consistent clustering of symptoms into a cognitive component, a negative affect component, and fatigue/low energy component. Drowsiness, trouble falling asleep, fatigue, and sensitivity to noise differentiated concussed players from demographically matched controls 24–48 hours following concussion. These results suggest that monitoring of baseline physical and cognitive symptoms is essential for interpretation of postconcussive symptoms.

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S. DIKMEN, J. MACHAMER, & N. TEMKIN. The Contribution of Neuropsychological Deficits to Functional Status in TBI.

Objectives: Examine the predictive and concurrent relationships between neuropsychological deficits and functional status at 3 to 5 years after injury. *Design:* Prospective longitudinal cohort study. *Setting:* Level I trauma center. *Subjects:* 216 adults with moderate to severe traumatic brain injury (TBI) enrolled within 24 hours of injury and prospectively followed for 3 to 5 years after injury. *Measures:* Brain injury severity (GCS, PTA), demographics (age, education, pre-existing conditions), WAIS PIQ at 1-month, Trail Making Test, and Functional Status Examination at 3 to 5 years. *Results:* Based on the FSE at 3 to 5 years the group was divided into Good, Intermediate, and Poor recovery groups. The results indicated greater likelihood of poor outcome with poor education, pre-existing conditions, and more severe TBI. However, PIQ at 1 month had the strongest relationship with functional status. For example, the odds of being a member of the Poor recovery group for a person with a PIQ of ≤ 85 was 7.24 times that of a person with PIQ of ≥ 100. In contrast, the odds of Poor group membership was 2.93 for the existence of pre-existing conditions, 2.81 for GCS of ≤ 8 in contrast to ≥ 13, 5.21 for PTA of ≥ 2 weeks as compared to ≤ 4 hours. The Poor group also had poorer concurrent neuropsychological performances (e.g., Trails B, 58 seconds for the Good, 63 for the Intermediate, and 105 for the Poor group). *Conclusions:* Multiple factors contribute to functional limitations after TBI. Neuropsychological deficits both predict and explain well some of the difficulties of these patients. Early neuropsychological deficits probably contain multiple sources of information including the effects of pre-existing conditions, the injury severity, and recovery. In addition, those abilities have direct relevance for day to day functioning.

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S. DIKMEN, J. MACHAMER, & N. TEMKIN. Emotional Difficulties 3 to 5 Years After Traumatic Brain Injury.

Objectives: Examine emotional adjustment 3 to 5 years after moderate to severe traumatic brain injury (TBI). *Design:* Prospective longitudinal cohort study. *Setting:* Level I trauma center. *Subjects:* 216 adults with moderate to severe TBI enrolled into the study within 24 hours of injury and prospectively followed for 3 to 5 years. *Main Outcome Measure:* Brief Symptom Inventory; structured interview of emotional difficulties before and since injury. *Results:* The BSI median subscale scores range from average to 1 *SD* above the mean of the normative group. Higher ratings occurred on subscales implying depression, cognitive problems, irritability, feelings of withdrawal and alienation, and overall distress. In addition, 56% of the cases received outpatient help since the injury difficulties primarily related to depression and anger management and 30% of the subjects received treatment for alcohol abuse. One third of the group had substantial functional limitations in everyday life and emotional difficulties in this group were prominent. For example, the BSI ranged from 1 to 2 *SD* above the mean, 74% had received outpatient help, 18% had inpatient hospitalization, 41% attended AA, and 28% were hospitalized for alcohol abuse. This group also had more severe TBIs, associated neuropsychological deficits, and pre-existing conditions. *Conclusions:* Emotional difficulties following moderate to severe brain injuries are prevalent even at 3 to 5 years after injury. Depression, anger/irritability, and alcohol/substance abuse are most frequent. Pre-existing conditions as well as brain injury severity and associated neuropsychological and functional limitations are related to increasing levels of emotional distress.

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J. GUNSTAD & J. SUHR. Influence of Depression, Headaches, and Treatment Seeking in PCS Symptom Report.

A growing number of studies show factors such as depression, pain, and subjective expectation may be more closely related to report of postconcussion syndrome (PCS) symptoms than head injury status. However, few studies have examined the possibility that treatment-seeking behavior may also influence PCS symptom report. Given that treatment-seeking tendencies have been linked to symptom differences in headaches and affective disorders, such a study seems overdue. The present study included 190 participants across 8 respective groups (headache, headache treatment seeking, depressed, depressed treatment seeking, head injured, head injured athlete, control, and athlete control) chosen to examine the contributions of head injury, depression, pain, athletic participation, and treatment-seeking behavior in report of current and past PCS symptoms. Participants were asked to report current rates of PCS symptoms and then to report rates of symptoms experienced at a specific point in the past. Results showed an interaction between group and symptoms over time: head-injured nonathletes, depressed persons, and tension headache sufferers that received treatment reported experiencing more current than past symptoms. Depressed persons, regardless of treatment seeking status, and

treatment-seeking headache sufferers reported elevated rates of current PCS symptoms relative to other groups. In addition, head-injured persons and headache sufferers underestimated the symptom baseline of controls. Overall, findings suggest that non-head-injury factors (treatment seeking, depression, and pain status) all contribute to PCS symptom report and expectations of "worse" cognition than the past. Results have major implications for the use of PCS symptom checklists in diagnosis of PCS.
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J. GUNSTAD & J. SUHR. PCS Symptom Clusters: Further Evidence for Nonspecificity?
A number of non-head-injury factors can lead to elevated postconcussion syndrome (PCS) symptom report, including depression, chronic pain, and treatment seeking, suggesting that PCS symptom report is not unique to head injury. However, no studies have examined the possibility that groups of persons within a population may report a similar symptom profile. In other words, do clusters of patients with unique PCS symptom profiles exist? Is there a unique PCS symptom profile for individuals with head injury? Following a factor analysis of a 97-item checklist (Gunstad & Suhr, 2001), the symptom reports of 690 individuals were scored for overall symptoms, rarely reported symptoms, memory complaints, distress, and metamemory strategies. A K-means cluster analysis was conducted, with four forced clusters. Cluster 1 consisted of individuals reporting low rates of symptoms for all factors. Cluster 2 individuals reported high levels of distress and moderately high rates on other factors. Cluster 3 reported high rates of memory complaints and moderately high rates of distress and metamemory strategies. Individuals in Cluster 4 reported high rates of distress, rarely reported symptoms, and metamemory strategies and moderate rates of memory complaints. Chi-square analyses found that proportionately more females and more depressed individuals were present in Cluster 3 than in other groups. No differences emerged among clusters for history of head injury or concussion. Findings suggest that unique profiles of PCS symptom report may be found in the general population, but do not suggest a unique PCS symptom profile associated with head injury history.
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J. SUHR & J. GUNSTAD. Diagnosis Threat: Effect of Expectations on Cognitive Performance in Head Injury.
Stereotype threat is a well-documented effect in which individuals faced with cognitive tasks thought to be poorly performed by members of a group to which they belong (i.e., racial group, gender group) perform worse than individuals who are not reminded of the stereotype. Some research suggests that this effect occurs because of increased anxiety, or perhaps because of reduced effort during task performance. The present study examined whether individuals who are part of a particular diagnostic group (head injury) would succumb to a "diagnosis threat" and perform worse on neuropsychological tests if they received information prior to testing that may lead them to have negative expectations for their own performance (a summary of research on cognitive effects of head injury). Thirty-six individuals with a history of mild head injury were randomly assigned to the diagnosis threat ($n = 17$) or a neutral condition ($n = 19$). Groups were equal in age, years of education, and head injury severity. The diagnosis threat group performed significantly worse on tests of memory and intellect, though they did not differ from the neutral group in attention and speed of information processing. The diagnosis threat group also rated themselves as putting forth less effort on tasks, having lower confidence and self-efficacy about their performance, and rated the tasks as more difficult than the neutral group. Findings have implications for the way tests are presented to individuals during clinical evaluation, and support the idea that preexisting expectations about performance can influence test findings above and beyond history of head injury.
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S.R. McCAULEY, S.A. BROWN, H.S. LEVIN, C. BOAKE, C. CONTANT, & J. SONG. Health-Related Quality of Life Perceptions in Patients With Postconcussional Disorder.
This study investigated the relationship between postconcussional disorder (PCD), as defined by the DSM–IV, and health-related quality of life (HRQOL) in a consecutive series of 150 patients (age range 16–91) with TBI (120 mild, 30 complicated mild/moderate). Of these patients, 38 (25.3%) met criteria for PCD at 3 months postinjury. Patients with PCD were not more likely to be involved in litigation or compensation related to their accident/injuries compared to those without PCD. No significant differences were found between the PCD and No-PCD groups for age, education, Injury Severity Score, admission GCS, or estimated premorbid IQ. Presence of trauma-related abnormalities on CT done <24 hours postinjury were not related to an increased incidence of PCD. PCD was not related to TBI severity. HRQOL was measured by the SF-36. Patients in the PCD group scored significantly poorer than the No-PCD on the Physical and Mental Component Summary Scales and all 8 subscales. Significantly fewer patients with PCD were rated as having a "Good Recovery" *vs* "Moderate Disability" on the Extended GOS. These results suggest that PCD is associated with poorer global outcome and that interventions to reduce PCD symptoms have the potential to significantly improve a patient's perceived HRQOL.
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S.A. BROWN S.R. McCAULEY, H.S. LEVIN, C. BOAKE, C. CONTANT, & J. SONG. Relationship Between Gender and Psychiatric Disorders after TBI.
Females reportedly have better outcome after TBI for resumption of premorbid role functioning; however, evidence suggests they have worse outcome for postconcussive symptoms. This study investigated gender differences in developing psychiatric disorders after TBI in a consecutive series of 150 mild/moderate TBI patients (105 male, 45 female). The groups did not differ in age, education, or admission-GCS score, 3-month GOS, and Injury Severity Scale score, but differed significantly for mechanism of injury. At 3 months postinjury, patients were assessed for presence of psychiatric disorders based on DSM–IV criteria (SCID); symptom severity using Center for Epidemiologic Studies–Depression (CESD), Visual Analog Scale-Depression (VASD), and PTSD Checklist; and for health functioning using SF-36. A significant difference was found for development of postconcussional disorder (PCD). Females were more likely to develop PCD than males (Fisher's exact $p = .025$). Although there was no significant difference in the proportion of male to female patients who met DSM–IV criteria for major depressive disorder or PTSD, females reported higher levels of depressive symptomatology on the CES-D ($p = .05$) and VASD ($p = .017$), and greater symptom severity on the PTSD Checklist ($p = .017$). Mental health functioning was also rated as worse by females than males on the SF-36 Mental Component Summary Scale ($p = .0042$) and each of its subscales, while no differences were found for physical health functioning. Results suggest that females may fare worse than males after mild TBI. They are at greater risk for developing PCD and experience greater emotional distress than their male counterparts.
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M. CROSSLEY, A. SHIEL, B. WILSON, L. GELLING, T. FRYER, M. COLEMAN, & J. PICKARD. Monitoring Emergence from Coma Following Severe Brain Injury in an Octogenarian.
This case study describes the emergence from coma of an 80-year-old female who suffered severe traumatic brain injury as a result of a car-pedestrian accident. She was seen as a participant in a multidisciplinary research project designed to investigate the relationships between behavioural and neurofunctional measures following severe brain injury. Emergence from coma was monitored behaviorally using the Wessex Head Injury Matrix (WHIM) which measures spontaneous behaviors, and responses to naturally occurring and to standardized stimuli. Neurofunctional measures (PET, transcranial magnetic stimulation, somatosensory

evoked potential, and EEG) were taken during the fourth week following injury as the patient was beginning to emerge from coma, and again, 6 months following brain injury when she was judged to have achieved her maximum level of recovery. 18-Fluorodeoxy-glucose PET studies indicated that the patient's global metabolic rate was suppressed by approximately 40% compared to age matched controls. There was no evidence of focal lesions and electrophysiological measures indicated that brain stem function was preserved. The patient suffered post traumatic amnesia for 14 weeks. Subsequently, she responded well to rehabilitation and was discharged home at 5 months under the care of her family. Neuropsychological testing at 6 months indicated that the patient had impaired memory and executive functions, but well preserved language and visual perceptual skills. She was able to walk with the aid of a frame, and reported an acceptable quality of life. In addition to demonstrating the links between behavioral and neurofunctional measures in the early assessment of recovery from coma, this case exemplifies the rehabilitation potential of premorbidly healthy older adults following severe brain injury.

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K. WILLIAMS, F. DOSSA, M. VETRANO, A. KLEINMANN, B. BALAZICH, L. IDONIBOYE, A. MILLER, & C. PEPPER. Chicken or Egg? The Course of Depression and Head Injury in an Outpatient Medical Population.

Although research has documented that individuals with a history of traumatic brain injury often experience significant depression, there exists only a paucity of research that has evaluated the temporal relationship between the onset of depression and traumatic brain injury. The current study evaluated this relationship by using semi-structured interviews with life events to establish the course of depression and head injury in a medical population of outpatients. Participants were 91 patients from 3 outpatient medical clinics. To assess for Axis I disorders, a history of head injury, and the temporal relationship between depression and head injury, all participants were administered the semi-structured clinical interview of the DSM–IV, the Head Injury Questionnaire, and life events interviews by trained graduate students who were blind to the research questions and hypothesis. Results demonstrated that 37 (40%) of all participants reported a head injury with a loss of consciousness. For the head-injured group 33% ($n = 12$) met the DSM–IV criteria for past or current major depression compared to only 9% ($n = 5$) of the non-head injured. Chi square analysis demonstrated a significant difference between groups on a history of alcohol abuse/dependence ($p < .01$) with 54% of the head injured group reporting meeting diagnostic criteria. Life events interviews demonstrated a pattern in the head injured group only of a history of alcohol abuse followed by a head injury and then a course of major depression. Results will be discussed in terms of prevention, treatment, and possibly etiology of depression.

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R.L. COLLINS, H. J. HANNAY, J.E. CASS, & A.B. VALADKA. Neuropsychological Test Scores Among Complicated Mild Head Injury Subtypes.

The term complicated mild head injury was introduced into the literature as a way to distinguish mild head injured patients (GCS 13–15) with abnormalities on a CT scan or MRI from those who do not. Previously, we compared the global outcome (GOS and DRS) of complicated mild head injured patients with stable GCS scores (Group 1) to a group of complicated mild head injured patients, from the same setting, whose GCS transiently dropped below 13 during the first 48 hours in the Neurosurgery Intensive Care Unit of a Level I Trauma Center (Group 2). It was demonstrated that Group 2 had a significantly worse outcome on the GOS at discharge and 1 month, but were similar to Group 1 on both measures at 3 and 6 months. In the present study, the same groups were compared on various neuropsychological measures (e.g., attention, memory, executive and motor functioning) at 3 and 6 months post injury. Groups were similar in age, education, gender, and ethnicity. Group 2 had a higher percentage of alcohol on admission, cranial surgery, entubation, and sedation for agitation. There were no significant differences between Groups 1 and 2 on neuropsychological measures at 3 or 6 months post injury. This is consistent with our previous report that the groups were similar in global outcome at 3 and 6 months.

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A. THORNTON, D. COX, A. POWTER, P. CORNEY, T. HIEBERT, M. KAYNE, T. NIWINSKA, & C. BLACKMAN. The Reliability of Self-Reported Concussions in Athletess.

Sixty active club rugby players were administered the Concussion Index Questionnaire on 2 occasions to establish the reliability of this newly developed self-report measure. Participants were selected to represent a variety of concussion exposure levels, and were asked to estimate their incidence of concussion at 3 levels of severity: (1) events involving full unconsciousness, (2) events involving confusion for a period of greater than 15 minutes, and (3) events involving confusion for a period of less than 15 minutes. The mean test-retest interval was 8 months. Three composite indices of concussion exposure were derived. Intraclass correlations were used to establish the test-retest reliability of the total number of concussions, the reliability of the most severe concussions, and the reliability of concussions selectively weighted on the basis of severity. All reliability coefficients exceeded .75, with the severity weighted index approaching .85. These findings establish that concussion history can be reliably self-reported. Further, the results provide a basis for future concussion studies that address the validity of self-report measures in indexing concussion history.

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V. WHITE, K. SULLIVAN, & R. MEUTER. I Get Knocked Down, Should I Get Up Again? Part I.

Many guidelines and policies have been written regarding the optimal time for a contact sport athlete to return to play after being concussed. However, little is known about the practices that are actually occurring "on the field." Specifically, the methods that coaches and trainers use to make return-to-play decisions and the factors that influence such judgments have not been systematically investigated. Participants from the present study were the primary return-to-play decision-makers and included coaches and sports trainers from across Australia representing various contact sports. They were asked by questionnaire what methods they used to make return-to-play decisions and the perceived value of these methods. The participants were also asked about their perceptions of the importance and efficiency of behavioral measures of brain functioning and neuropsychological testing in relation to return-to-play decisions, as well as their general knowledge of concussion and its cognitive effects on athletes. Results indicate there is variable knowledge of the symptoms of concussion and also that the methods of decision making in return-to-play judgments are not consistent within and across sports.

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C.A. PIERCE & N.L. FICHTENBERG. Impression Management: TBI and the MMPI–2 FBS.

Impression management is one way to characterize the performance of certain examinees on psychological assessment. Various methods have been used to assess the degree of nonoptimal effort in the presentation of cognitive status on neuropsychological tests and emotional status on personality tests. The present study examined the performance of 3 distinct subject groups on the FBS of the MMPI–2. On the basis of the patient's history and performance on effort measures patients were classified as mild TBI ($n = 17$), moderate to severe TBI ($n = 80$), or malingering cognitive dysfunction ($n = 31$). Looking at bona fide TBI cases, FBS

scores did not correlate significantly with GCS or length of loss of consciousness. Furthermore, whether or not TBI patients were in litigation, FBS scores were not significantly different. Nevertheless, comparison of all 3 groups demonstrated significant differences on the FBS, with the malingering group scoring highest, with a mean above an established cutoff for the scale. In other words, 61% of malingering subjects scored above the cutoff for the FBS, while 92% of TBI patients scored below the cutoff. These results suggest that examinees who have already displayed an inclination to misrepresent their cognitive status tend to be willing to engage in "impression management" across other domains as well. While the FBS is not a measure of cognitive malingering, it is associated with inflated somatic complaints and dubious assertions of injury-related disability. Thus, elevated FBS by those subjects who misrepresent their cognitive status may indicate a more generalized willingness to falsely portray injury consequences.

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J. LENGENFELDER, N.D. CHIARAVALLOTI, & J. DeLUCA. Examining the Generation Effect in Individuals With Traumatic Brain Injury.

The generation effect (GE) is the observation that items self-generated by subjects are better remembered than items provided by the examiner. While the GE has been shown to be relatively robust within the normal population, few studies have examined the usefulness of the generation effect in improving learning and memory abilities in neurologically impaired individuals. This study examined the generation effect in a group of 14 individuals with moderate-severe traumatic brain injury (TBI) compared with 17 healthy control subjects (HC). Results indicated that the GE was present across both groups ($p < .01$) such that both groups recalled information that was generated better than when it was provided by the examiner. However, the HC group showed greater benefit from the GE than the TBI group ($p < .05$). As expected, while recall performance diminished over time (i.e., immediate recall, 30-min, 1 week; $p < .01$) forgetting did not differ between the TBI and HC groups ($p = .14$). A similar pattern of results was found for recognition performance. The finding that recall and recognition is improved when material is self-generated may have implications for improving the cognitive rehabilitation of learning and memory.

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S. PLUTH, H.J. HANNAY, P.J. MASSMAN, & C.F. CONTANT, Jr. Selective Reminding Test: Novel Measures of Performance in a CHI Population.

The Selective Reminding Test (SRT) has proved to be useful for the clinical assessment of memory performance. Its use has been limited, in part, by the comparatively small number of summary performance measures available from a typically scored protocol and from the lack of a computerized scoring program. The SRT is unique among list-learning tasks in that the complete word list is not presented on each trial. Its selective presentation of words on each trial permits the creation and examination of novel measures of learning and memory performance. The present study describes several new measures similar to those on the CVLT that can be derived from a traditionally scored SRT protocol, including primacy/recency, learning across trials, consistency of item recall, semantic/phonological errors, and contrast measures. We then introduce a new method of scoring the SRT that records the exact serial order of list words, intrusions, and perseverations. This scoring method adds no time or modifications to the traditional SRT administration and yet it permits the generation of many new measures including perseverations, interval between presentation and recall, clustering score, proportion of presented and unpresented words correctly recalled, and discrimination. Data consisting of head injured patients from an acute level one trauma center are presented using measures derived from both the traditional and the new scoring methods. We attempt to demonstrate the clinical utility of the proposed measures in relation to their initial severity of injury, Disability Rating Scale (DRS), and Galveston Orientation and Amnesia Test (GOAT).

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E. VAKIL, A. KRAUS, B. BOR, & Z. GROSWASSER. Skill Learning in CHI Patients as Demonstrated by the Serial Reaction Task.

A group of 19 patients who sustained closed-head injury (CHI) and a matched control group of 19 individuals were tested on the serial reaction time (SRT) task. Three different measures were generated from the task: 2 implicit and 1 explicit sequence learning measures were analyzed. The 2 implicit sequence learning measures include: (1) the learning rate on the first 5 trials of the repeated sequence, assumed to reflect primarily general reaction time learning; and (2) the difference between the fifth block of the repeated sequence and the sixth block, a random sequence that reflects implicit sequence-specific learning. In addition, an explicit measure of sequence learning is also obtained (i.e., Generate). The results indicate that the CHI group was impaired on the explicit measure of sequence learning. The groups did not differ on one of the implicit measures of sequence learning (i.e., general reaction time learning). However, the control group was superior to the CHI group in learning the specific sequence repeated in the SRT task. This pattern of results is unique to the CHI group, corresponding neither to that of amnesic patients nor to that of patients with damage to basal ganglia (i.e., Parkinson's and Huntington's diseases).

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E. VAKIL & Y. ODED. Cued Recall, Priming, and Saving in CHI Patients.

Twenty closed-head injury (CHI) patients and 20 matched controls were tested with 3 different tasks: cued recall, word stem completion (WSC), and saving. It was predicted that CHI patients would be impaired when memory is measured with an explicit task (i.e., cued recall), but would be preserved when memory is measured with an implicit task (i.e., WSC). The question addressed in this study is whether the memory of CHI patients will be impaired when memory is tested with a saving task. The findings confirm impairment of CHI patients in explicit memory, although the learning rate is preserved when using a cued recall task. Priming is preserved in CHI patients only when based on reactivation of preexisting knowledge, but not when dependent on forming new associations. Finally, the CHI patients, even after the 2-week delay, demonstrated a significant saving in relearning old, as compared to new pairs of words, which were not remembered in free recall. The clinical contribution of this study is the delineation of those aspects of memory that are impaired and those that are preserved in CHI patients. The theoretical implications of the finding that memory could be preserved in CHI patients when measured by saving are discussed in terms of the relationship between implicit memory and saving.

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R. GREEN & B.P. SCHERZER. Verbal Regulation and Traumatic Brain Injury Survivors: The Effect of a Concurrent Monologue (CDM) on an Activity of Daily Living.

This study was done to determine what effect, if any, a concurrent descriptive monologue had on the performance time and precision of that task in a population of people surviving a traumatic brain injury (TBI). The CDM requires the participant to describe aloud his/her actions while doing them. In this study, the experimental task was to find 8 specific items in a given grocery store aisle. In the control condition, the task was performed silently; in the experimental condition, the CDM was maintained throughout until the 8 items were correctly chosen. There were 6 control and 6 experimental trials. Research done on verbal mediation on behavior has shown encouraging results in terms of precision and, under some circumstances, time. The CDM was proposed as a possible compensatory tool to improve the cognitive functioning in people with executive dysfunction. It was hypothesized that there would be an improvement in precision on the

task; there was no hypothesis about the effect of the CDM on performance time. Eight men and one woman having had a TBI resulting in a loss of consciousness participated in the study. All participants had documented executive dysfunction; some also had physical disabilities including dysarthria and motoric slowing. Results showed no significant effect of the CDM on time or precision in the experimental group, nor was there any learning effect. Six individuals, however, showed a clear benefit on either performance time, precision, or both. Three showed no improvement on either measure.
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M. OAK & J.F. MALEC. Predicting Functional Status Using Neuropsychological Test Data.
This study examined the utility of neuropsychological tests in predicting real-world functioning in a brain-injured population. One-hundred-fifteen participants (72 male, 43 female; Mean age = 35.72, *SD* = 13.30; Mean education = 13.13, *SD* = 2.00) underwent a comprehensive neuropsychological exam as part of an outpatient rehabilitation evaluation. Eighty-one percent sustained a traumatic injury, 12% had a cerebrovascular accident, and 7% were mixed. Functional status ratings were obtained using the Mayo-Portland Adaptability Inventory (MPAI; Lezak & Malec, 2000). The MPAI is a rating scale that measures emotional behavior, functional abilities, and physical disabilities. A global score provides an index of general functional status. Factor analysis of neuropsychological measures identified 7 underlying cognitive domains used as predictors. These factors accounted for 69% of the total variance and included: (1) Visual-Spatial Processing, (2) Learning/Memory, (3) Verbal Processing, (4) Processing Speed, (5) Executive Functions, (6) Basic Language, and (7) Perceptual Planning. Standard multiple regression analysis was conducted using the above factors to predict functional status. Results revealed a significant prediction equation accounting for 33% of the variance ($F = 8.87$, $p = .000$). Factors 1 ($t = -5.27$, $p = .000$), 2 ($t = -3.37$, $p = .001$), 3 ($t = -2.98$, $p = .004$), and 4 ($t = -3.82$, $p = .000$) contributed significantly. *Post-hoc* analyses using logistical regression on selected MPAI items also showed significant equations. Results suggest that neuropsychological data may assist in drawing valid inferences about real-world functioning. The clinical implications of this study are discussed.
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K. GANESALINGAM, V. ANDERSON, A. SANSON, & F. HARITOU. The Effects of Pediatric Traumatic Brain Injury on Self-Regulation and Social Functioning.
Difficulties in social functioning have been frequently reported following pediatric traumatic brain injury (TBI), and are believed to reflect the relative vulnerability of the prefrontal cortex to damage. While 20%–40% of children post-TBI experience difficulties in social functioning, in particular behavior problems and social skill deficits, research has not yet identified an underlying mechanism causing these difficulties. The present study proposes that the construct of self-regulation is a core deficit in children who present with difficulties in social functioning 2 to 5 years following moderate to severe TBI. Self-regulation is a biologically based attribute that develops from birth, and is governed by the prefrontal cortex. Self-regulation could be defined as an individual's capacity to manage his/her own thoughts, emotions, and behavior in adaptive ways. Self-regulation therefore includes cognitive, emotional, and behavioral domains. Results of the present study of 6 to 11 year-old children, 2 to 5 years following moderate to severe TBI ($n = 25$), and age and gender matched control participants ($n = 25$) are described. The Matching Familiar Figures Test, a Children's Emotional Self-Regulation Measure, and a Delay of Gratification Task were used to assess the 3 domains of self-regulation. Findings indicate that children with TBI have significantly lower levels of cognitive ($p < .05$), emotional ($p < .05$), and behavioral ($p < .05$) self-regulation than their noninjured peers. Results are discussed in terms of self-regulation playing a mediating role between pediatric TBI and post-TBI difficulties in social functioning, and whether the level of self-regulation predicts the degree of difficulties in social functioning.
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D. SALISBURY, J. WILLIAMS, J. ALLEN, & W. ARNOLD. Neuropsychological Predictions of Employability After Brain Injury.
While the severity of cognitive deficits have been strongly linked to reentry to the workforce and neuropsychological measures have been shown to be predictive of vocational outcome, no consensus has been reached regarding the most salient predictors of employment (Cifu et al., 1997). This research is an effort to expand the knowledge base of the neuropsychological measures as they relate to vocational success. Archival data is being collected from an outpatient rehabilitation program. The subject pool will be comprised of a total of 75–100 subjects with varying degrees of brain injury and who were served between the years of 1995 and 2000. Preliminary data has been gathered on 42 subjects (32 males, 10 females) between the ages of 21–61. Presently, numerous neuropsychological tests have been significantly correlated with employment wage following rehabilitation. The Perceptual Organization Index [$r(36) = .4418$, $p = .006$] and Processing Speed Index [$r(38) = .4313$, $p = .006$] of the WAIS–III, the Auditory Recall Delay subtest of the WMS–III [$r(29) = .5623$; $p = .001$] and long delayed free recall of the CVLT–II [$r(32) = 5096$, $p = .002$] have shown strong correlations to wage. Interestingly, the Tactile Performance Test appears to have the strongest correlation with both job placement status [$r(27) = -.4871$, $p = .009$] and wage [$r(29) = .3658$, $p = .047$]. Further analysis will focus on regression equations incorporating demographic and treatment variables.
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J. WILLIAMS, D. SALISBURY, J. ALLEN, & W. ARNOLD. MMPI Scales as Predictors of Employability After Brain Injury.
Research has shown that personality variables may be stronger predictors of employment than cognitive factors alone among individuals with brain injury (Heaton, Gordon, Chelune, & Lehman, 1978). The intent of this research proposal is to determine within the Multiphasic Minnesota Personality Inventory (MMPI), specific scales that predict employment status and quality of employment among individuals with brain injury. Data is being collected from existing archival data obtained from an outpatient rehabilitation program. The subject pool is comprised of a total of 75–100 subjects with varying degrees of brain injury. All of the subjects selected for this study completed a comprehensive evaluation and were subsequently admitted into the vocational rehabilitation program between the years of 1995 and 2000. A preliminary simultaneous multiple regression was performed on 42 subjects (32 men and 10 women) aged 21 to 61. The following scales were included in this multiple regression: Fake Bad, Depression, Psychopathic Deviate, Hypomania, Anxiety, Work, and Anger. The *F* scale was found to be a significant predictor of wage [$F(7.30) = 2.57$, $p = .0093$]. The implication of this finding is that, an invalid MMPI–2 may offer ecologically valid and predictive information in rehabilitation settings. Additional, stepwise regressions will be performed in order to develop a regression equation that best predicts employment status and wage following rehabilitation. The results of this study will be used to provide guidelines as to how to incorporate personality characteristics into vocational rehabilitation treatment planning and job placement.
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J. KIXMILLER & M. J. SAUVE. Generalization of Mnemonic Memory Skill Training in a Patient with TBI.
Memory deficits, common with traumatic brain injury, are often targeted for rehabilitation. Mnemonic training is a common intervention used for memory problems, although these techniques are not firmly validated and

have often failed to generalize to real world settings. In this case study, mnemonic training using semantic/conceptual clustering (or "chunking") and visual imagery were used to help patient R.R. recall long lists of to-be-remembered items. Training consisted of 12 sessions of computerized, patient-paced, tutored exposure and practice in creating conceptually/semantically related subgroups of to-be-recalled items and then visualizing these subgroups/chunks. Training also included explicit prompts to use these skills in real world settings. Learning measures across training documented improved performance in clustering and recalling lists over 20-min delays. Functional performance on a pre-post comparison of incidental performance on a community-based grocery store shopping task supported the transfer of these mnemonic skills in terms of improved functional performance. Namely, R.R.'s recall of a long shopping list improved significantly after training without further prompts to use the mnemonic strategies (pre-training: 9/16 items, 4 intrusions; post-training 15/16 items, no intrusions). Qualitatively, R.R.'s approach to shopping was much more efficient and organized as well (e.g., total shopping time: pre-training: 28.3 min, post-training: 18.6 min; repealed aisles, pre-training: 9, post-training: 2; "random" aisles: pre-training: 11, post-training: 2). Findings preliminarily support the efficacy of chunking/clustering for recalling long lists of information. Further, generalization of these mnemonic skills can be seen with explicit prompts/reminders during training to use such skills in appropriate situations.

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L. RITCHIE, L. McINTYRE, & D. ALFANO. Base Rates of DSM–IV Postconcussional Disorder Symptoms in Healthy Young Adults.

Valid symptom criteria are essential to the diagnostic utility of the DSM–IV. The establishment of base rate data regarding DSM–IV symptoms in healthy populations is therefore critical. Postconcussional disorder (PCS) is a newly proposed diagnostic entity for research purposes in the DSM–IV. This study was conducted in order to determine the base rate of the 8 symptoms of PCS proposed in the DSM–IV as diagnostic for this disorder. Sixty healthy young adults between the ages of 18 and 25 completed a recently developed Neurobehavioural Symptom Inventory (NSI) that included items specifically associated with PCS according to DSM–IV criteria. The mean number of total symptoms endorsed was found to be 1.9 (SD = 1.9). The base rate of the total number of symptoms endorsed at 1.0, 1.5, and 2.0 standard deviations from the mean were 10.0%, 6.7%, and 1.7%, respectively. The base rate of the recommended DSM–IV cutting score for PCS of 3 or more symptoms was 21.7%. Based on these findings, the currently recommended DSM–IV cutting score for PCS of 3 or more symptoms has a relatively high base rate in healthy young adults. A revised cutting score of 4 or more symptoms would seem to be a potentially more valid one. Future studies are aimed at determining the diagnostic utility of DSM–IV symptom criteria for PCS in clinical samples using the newly developed NSI.

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J.L. WOODARD, C.D. MARKER, F.E. TABANICO, S.K. MILLER, E.S.W. DORSETT, L.R. COX, F. GOULD, & J. BLEIBERG. A Validation Study of the Automated Neuropsychological Assessment Metrics (ANAM) in Non-Concussed High School Football Players.

Baseline cognitive testing is necessary to establish a frame of reference against which to compare a player's subsequent test performance following concussion. However, even a brief battery of paper-and-pencil cognitive measures can take 30 minutes or longer, and the battery must be administered individually, necessitating considerable demands on available testing resources. A new generation of computer-based cognitive test instruments has recently emerged, permitting cognitive testing in groups and typically taking less than 15 minutes. We examined the validity of a 15 minute version of the computer-based Automated Neuropsychological Assessment Metrics (ANAM) *versus* traditional paper-and-pencil instruments commonly used in concussion research: Wechsler Adult Intelligence Scale–III Digit Symbol-Coding (DSC) and Symbol Search (SS), Brief Test of Attention (BTA), Hopkins Verbal Learning Test–Revised (HVLT–R), Controlled Oral Word Association (COWA), Pennsylvania State University Cancellation Task (PSU), and a postconcussive symptoms scale (PCS). Participants included 20 varsity high school football players tested prior to the 2000 football season with paper-and-pencil measures and again at postseason with paper-and-pencil measures and the ANAM. Multiple regressions demonstrated consistent significant relationships between both baseline and postseason paper-and-pencil measures and throughput scores for the following ANAM subtests: Mathematical Processing (DSC, HVLT–R immediate and delayed recall, PCS), Matching-to-Sample (SS, PSU), and Memory Search (HVLT–R immediate recall). ANAM Code Substitution and Simple Reaction Time showed no consistent associations with the paper-and-pencil measures. We conclude that the ANAM is a valid instrument for assessing cognitive functioning in less than 15 minutes, compared with a 30-minute or longer battery of paper-and-pencil measures.

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Poster Session 2/8:00 a.m.–12:45 p.m.

REHABILITATION

M. CANNIZZARO & C. COELHO. Treatment of Story Grammar Abilities Following Traumatic Brain Injury.

Numerous recent investigations have documented the occurrence of various discourse deficits following traumatic brain injury (TBI). Such deficits have serious implications for TBI survivors with regard to social reintegration and quality of life. However, there is a paucity of information relating to the treatment of such deficits. The present study investigated the treatment of discourse production deficits, specifically story grammar ability, in an individual with TBI. Treatment emphasized metalinguistic comprehension of story grammar structure, and the identification of episode components and multiple episodes within stories. Over the course of treatment, an increase in the number of complete episodes generated by the TBI subject in story grammar probes was noted. Follow-up data at 1 and 3 months post-treatment indicated a rapid decline in the subject's production of complete episodes to near baseline levels. Inconsistent carryover and poor generalization of the treatment effects were seen during the study and following the cessation of the treatment program. Findings are interpreted in terms of the individual's chronic cognitive deficits, specifically, disruptions in managerial knowledge, as well as the limitations of treating discourse acontextually.

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A.M. BROWN-DeGAGNE & S. KENNEPOHL. Ethnic/Cultural Considerations When Assessing Family Needs Following Acquired Brain Injury.

There has been an increased awareness over recent years of the importance for rehabilitation professionals to better understand and address the needs of families in the context of an acquired brain injury. Standardized measures have been developed to assess family members' perceived needs following a relative's brain injury, as well as the extent to which these needs have been met (e.g., Family Needs Questionnaire; Kreutzer, 1988). However, there has been minimal research investigating the potential role of ethnic/cultural factors in this population. In multicultural societies there is some evidence suggesting that minority groups are over-represented in the disabled populations, including traumatic brain injury (TBI) and stroke. Indeed, there is preliminary evidence that minority status may affect fam-

ily members' reported needs and/or the extent to which these needs are met (Kreutzer, Serio, & Bergquist, 1994). The following study specifically examined the needs of families following acquired brain injury in a multicultural Canadian population. In addition to the Family Needs Questionnaire, participants in this study completed a measure of ethnic identity (i.e., the Multigroup Ethnic Identity Measure; Phinney, 1992). Factors relating to family needs following brain injury will be discussed, including the importance of addressing ethnic/cultural issues when assessing the needs of families following brain injury

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R.A. ADAMS, M. SHERER, M.A. STRUCHEN, S. DICKSON, & R. NAKASE THOMPSON. Post-Acute Rehabilitation Outcome in Stroke Patients.

While there has been extensive investigation of post-acute brain injury rehabilitation (PABIR) for persons with traumatic brain injury, there has been limited investigation of the efficacy of such services for persons with stroke. The present study examined benefit from PABIR and predictors of status at discharge in a sample of 95 stroke patients (predominantly subarachnoid hemorrhage due to aneurysm). There were 39 males and 56 female participants. Quartiles (25th, 50th, and 75th percentiles) for age at stroke, years of education, and days from stroke to admission (chronicity) were 40.7, 48.7, and 55.4; 12, 14, and 16; and 43, 88, and 195, respectively. Additional variables used to predict productivity status (PSD) and supervision needs (SND) at program discharge were premorbid productivity status, admit productivity status, and admit supervision needs (ASN). Sixty-one of 95 (64%) patients showed increased productivity status from admission to discharge while 63 of 95 (66%) showed decreased need for supervision from admission to discharge. The independent variables predicted 19.6% ($F = 3.586$, $p \leq .01$) and 24.7% ($F = 4.814$, $p \leq .01$) PSD and SND, respectively. Chronicity (partial correlation = .287) and age (parietal correlation = .273) made the greatest contributions to prediction for PSD, while ASN (partial correlation = .451) made the greatest contribution to prediction for SND. The results provide tentative evidence that patients with strokes benefit from PABIR. Outcome was predicated by age, chronicity, and functional status at admission.

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I. ROULEAU, D.P. SALMON, & M. VRBANCIC. Pronostic Value of Mirror Tracing Adaptation Deficit on the Progression of Dementia in Alzheimer's Disease.

Although patients with Alzheimer's disease (AD) generally learn motor skills normally, a significant proportion of patients show severe initial performance (or adaptation) deficits similar to patients with frontal lobe lesions, on some tasks [e.g., the Mirror Tracing (MTr) task] (Rouleau, Salmon, & Vrbancic, in press). The potential for this adaptation deficit to predict progression of dementia was assessed by examining neuropsychological data collected from 12 AD patients over 3 annual evaluations that occurred subsequent to their participation in our initial study of MTr motor skill learning. Although patients with ($N = 6$) and without ($N = 6$) an MTr adaptation deficit differed only on tests of executive functions on the initial evaluation (and not on general severity of dementia, or language, memory, and visuoperceptual functions), the follow-up evaluations revealed that, 3 years later, patients with MTr adaptation deficits were significantly more demented than those without these deficits (Dementia Rating Scale: 76.1 *vs.* 112.6). In fact, while all AD patients without an MTr adaptation deficit could complete the comprehensive neuropsychological test battery at the 3-year follow-up evaluation, all patients with an adaptation deficit required a shorter battery adapted for severely demented patients. Although it is not possible, with the available data, to confirm any hypothesis concerning the relationship between the MTr adaptation deficit and progression of dementia, we cannot exclude the possibility that the additional frontal lobe pathology suggested by the executive dysfunction observed in a subgroup of AD patients might reflect a more pervasive form of the disease.

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D. CAHN-WEINER, P. MALLOY, R. READY, B. OTT, & G. REBOK. Preliminary Results of a Memory Training Intervention for Alzheimer's Disease Patients.

The efficacy of a memory-training program to improve word-list recall and recognition was evaluated in 28 patients with probable Alzheimer's disease (AD). The patients, who were all taking donepezil throughout the 6-week intervention, were randomly assigned to a cognitive intervention group or a placebo group. The placebo group consisted of didactic presentations, but no formal memory training. Patients were assessed on neuropsychological tests prior to the 6-week training program and 2 months following completion of the training. Caregivers, who were blind to group assignment, completed Activities of Daily Living (ADL) questionnaires at both time points. No significant main effects of group (training *vs.* placebo) or time (baseline *vs.* 2-month follow-up) were observed on any neuropsychological measure, nor were any significant interactions found. On 1 ADL questionnaire, there was a significant group by session interaction ($p < .05$), and *post-hoc* comparisons revealed that while the control group showed a borderline significant decline in ADL's ($p = .10$), the training group showed no significant change. In terms of performance during the 6-week training program, the patients demonstrated significant improvement on both recall and recognition of test material presented during the training sessions. These results suggest that while modest gains in learning and memory may be evident in AD patients who are taught specific strategies, the benefits do not generalize to other measures of neuropsychological functioning following the intervention. These preliminary data suggest that there may be relative stabilization of functional abilities in patients who undergo memory training compared to a slight decline evidenced by patients who do not receive the same intervention.

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C. EVANS, S. McCAULEY, H. LEVIN, C. BOAKE, C. CONTANT, & J. SONG. Comparison of the CIQ and EGOS as Measures of Outcome in Mild to Moderate TBI and a Matched General Trauma Sample.

The Extended Glasgow Outcome Scale (EGOS) and the Community Integration Questionnaire (CIQ) currently represent 2 reliable and valid measures of outcome with traumatic brain injury (TBI) populations in rehabilitation settings. However, their sensitivity in detecting levels of disability in mild to moderate TBI samples has been questioned. The present study investigated the utility of the EGOS and CIQ in measuring outcome at 3 months post-injury in 2 samples from a level-1 trauma center: (1) mild to moderate TBI group and (2) general trauma population (GT). The domain overlap between the EGOS and the CIQ for both populations was also examined. Participants included 150 patients who received a diagnosis of mild to moderate TBI while in the Emergency Center (EC) or inpatient hospital unit, and 87 GT patients with no injury to the head recruited from EC and inpatient units. There were no significant between group differences on demographic or injury severity indices. All patients were administered the CIQ and EGOS at 3 months post-injury as part of their participation in a larger research project. Analyses revealed that 41% of the GT and 45% of the TBI samples were reporting moderate levels of disability on the EGOS at 3 months post-injury. The EGOS was significantly associated with the CIQ Total Score in both TBI ($p < .001$) and GT ($p < .05$) populations, largely as a function of its correlation with the CIQ Productivity subscale ($r = .51$, $p < .0001$, and $r = .43$, $p < .0001$ respectively). For the TBI group only, the EGOS was significantly correlated with the CIQ Social Integration Scale as well ($p < .01$). Results suggest that the EGOS and CIQ are useful in measuring both shared and unique injury-related effects of GT and mild to moderate TBI.

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R. BAKER, P. BERGER-GROSS, N. KARMAN, & J. MARYLES. Application of Constraint Induced Movement Therapy on Children with TBI.

Based upon basic research with monkeys, Taub developed a rehabilitation technique to improve the functional ability of the affected upper extremity (UE) of hemiplegic adult stroke patients. His procedure involves restraining the uninvolved UE, and is termed Constraint Induced Movement Therapy (CIMT). We modified Taub's protocols to treat 3 hemiplegic children with traumatic brain injuries (TBI). Prior to starting CIMT the children were videotaped performing a series of structured tasks, using the Actual Arm Usage Test (AAUT). For 2 weeks they were engaged 6 hours/day in motor tasks that elicited fine and gross movement of the affected UE while wearing a mitten on the other hand. They were then videotaped performing the same structured tasks. Two of the 3 children showed measurable improvement on the AAUT post-treatment assessment as compared with baseline. There was increased usage of the hemiplegic limb on tasks with no instruction as to which hand to use. The results are promising, and suggest that further controlled studies using CIMT with hemiplegic TBI children are warranted.

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L.M. MAHER, F. SINGLETARY, J.A. SWEARINGEN, M.C. CLAYTON, L.A. VINCENT, A.B. MOORE, C.E. WIERENGA, B. CROSSON, D. KENDALL, & L. J. GONZALEZ-ROTHI. An Errorless Learning Approach to Sentence Generation in Aphasia.

Mapping TX has been demonstrated to be effective in improving sentence production in some individuals with agrammatism, but it remains unclear which factors contribute to the relative success or failure in a given patient. We explored 2 methods of Mapping TX delivery. Two subjects underwent Mapping TX under 2 different conditions: (1) an errorless learning condition, with the correct sentence model provided prior to responding, plus a color and spatially coded mapping template focusing on the thematic role positions of the major lexical items in the sentence; and (2) a traditional condition where the subjects first attempted to produce the target sentence independently, and errors were addressed using a correction procedure and the mapping template. While both subjects appeared to benefit from both types of TX delivery, their TX profiles reflected different patterns of performance. Subject 1's TX response appeared to be item specific, demonstrating improvement only on those sentences used in therapy. Subject 2 demonstrated dramatic improvement for both treated and untreated sentences, suggesting improvement in the process of sentence generation rather than item-specific effects. Pre-TX and post-TX fMRI suggested subtle changes in brain activation following treatment. This study suggests an errorless approach has potential for improving sentence generation in aphasia.

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J. DEMERY, C. GIUFFRIDA, & R. HANLON. Acquisition, Retention, and Transfer of Novel Skill in Traumatic Brain Injury.

High contextual interference, practicing several tasks in a random order, results in depressed performance in *acquisition*, but enhanced *retention* and *transfer* performance for random relative to blocked practice. Conversely, when tasks are practiced in a blocked order, *acquisition* is enhanced while *retention* and *transfer* benefits are minimized. We attempted to determine the effects of different practice schedules on functional skill learning in patients with significantly impaired processing speed, learning and memory, and fine motor control following traumatic brain injury (TBI). Six male participants (*M* age, 28 years old) with chronic severe TBI practiced 3 functional tasks (e.g., touch typing, use of adding machine, learning subway schedule) using either a random or a blocked practice schedule. Practice occurred for 55 minutes each day for 13 days with retention and transfer trials at 1 and 2 weeks post-training. Within group analyses showed significant improvements in skill performance for both groups relative to baseline. These gains were maintained by the random practice group but not the blocked practice group when measured at retention and transfer trials. Between group analyses generally noted no group differences in percent improvement from baseline (acquisition), but the random practice group showed significantly better performance on retention and transfer trials. Performance on the digit symbol tests was significantly related to skill performance. These data provide partial support for the use of differential practice schedules in skills training following TBI and provide ecological validity for neuropsychological tests in predicting skill performance.

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C. MATHIESEN, J. KIXMILLER, & R. FITZSIMMONS. Prospective Memory Assessment and Memory Management of a Dementia Patient.

Memory impairment, a hallmark of dementia, is usually assessed in terms of retrospective memory. However, prospective memory, remembering to perform a future action, also deteriorates in dementia patients, and this impairment may be more detrimental to daily functioning than the more commonly studied retrospective memory deficits. Research indicates that individuals with severe memory impairment can benefit from cognitive rehabilitation, perhaps making use of more intact procedural memory systems. The current case study was a rehabilitation intervention designed to train a demented inpatient (MMSE 19/30) to more consistently and independently perform both a time-based (attend neurocognitive group) and an event-based (take medication surrogate) prospective memory task. The goal was to assess the efficacy of 2 3-week interventions to enable the patient to perform these activities independently despite his significant memory impairments, thereby improving his daily functioning. The MMSE, Blessed DRS, Clock Drawing, Rivermead Behavioral Memory Test, and Geriatric Depression Scale were administered before and after each 3-week training module. Training sessions employed errorless learning and vanishing cue strategies. While the patient's neuropsychological test scores did not improve, functional improvements were documented. Following training, he more consistently attended a scheduled group with decreased staff help (attendance increased from 30% to 80%) and learned to take a medication surrogate after an alarm (100% accuracy). The value of including prospective memory tasks in routine neuropsychological assessments and the details of the current training and findings will be discussed.

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M.A. PASSLER & T.L. CULVER. A "Cognitive Jumpstart" Protocol for Treating Traumatic Brain Injured Minimally Conscious Patients.

The low level traumatic brain injury (TBI) patient which includes the vegetative state (VS) and the minimally conscious state (MCS) patient, has had a poor prognosis for recovery. Treatment and rehabilitation advances in this area have been minimal. The purpose of this investigation was to establish a protocol for treatment of the TBIMCS patient and demonstrate positive outcome. In this study, 8 TBIMCS patients were treated in an acute inpatient rehabilitation facility using methylphenedate and bromocriptine in conjunction with traditional physical, speech, and occupational therapy. Neuropsychological measures established baseline level of cognitive functioning and allowed for monitoring response to treatment. Outcome measures for this group were compared with previously published outcome measures for TBIMCS patients. The patients in this study surpassed expected gains, leading to greater functional ability in a shorter period of time. Results suggest benefit from a "cognitive jumpstart." This study offers a suggested protocol for using methylphenedate and bromocriptine along with neuropsychological assessment and traditional rehabilitation therapy.

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G. PUSSWALD, N. STEINHOFF, & C. MÜLLER. A Pilot Study: Acoustic Feedback of Eye Movement—A New Method of Neglect Treatment.
Visual unilateral inattention is often discussed in cognitive impairment. Several hypotheses exist which try to explain unilateral neglect as an attention deficit, a disturbance of the coordinates, or a displacement of mental visuality. According to theories, there exists a lot of concepts of therapies like exploration, personal inventions like neck vibration, and fresnel glasses, as well as cognitive inventions like feedback, video feedback, and using cues. As some authors describe, some inventories have no enduring or transformative effect. Others have had success by combining methods like vibration and exploration. Some methods stress the fact that patients are not aware of their misbehavior. They cannot control their attention shift or their eye movements and need an external cue to lead their attention to the neglected side. Our method includes an acoustic feedback of eye movements. The intention of using this kind of treatment was first of all to support the awareness of the patients by feedback of their behavior, secondly to improve saccadic and follow eye movements by following a target, and thirdly to improve sustained attention. In a pilot study, 2 patients with unilateral neglect received a feedback treatment of 15 sessions. A three-month follow-up evaluation investigated the stability of the treatment effects. The criteria are reading and reaction time. On this poster we describe the method of acoustic feedback of eye movement. Further, we present the results of the evaluation of the feedback training. We found a decline in word omissions in reading and an improvement in reaction time.
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P. McMULLEN. Category-Specific Visual Agnosia for Living Objects: A 10-Year Follow-Up.
Last year, M.B., a 40-year-old, with a category-specific visual agnosia for living objects was tested for her ability to: (1) match line drawings of living and nonliving objects to names of objects at different levels of identity and (2) to name the same objects aloud. These results were compared to results from similar tests that were administered 10 years ago. In 1989, she correctly named 35% of living and 78% of nonliving objects. Her ability to discriminate real objects from unreal ones in an object decision task resulted in *d*'s of 0.4 for living and 1.21 for nonliving objects. Control subjects performed this task with *d*'s of 2.7 and 2.8 respectively. Her matching of object names and pictures indicated a living deficit, especially for mismatches between objects and subordinate names. Her performance on a semantic questionnaire about living and nonliving objects indicated impaired knowledge of living things. These results confirmed M.B.'s status as a category-specific visual agnosic for living objects. In 2000, M.B. showed a normal performance when living and nonliving objects were matched with superordinate (e.g., animal), basic (e.g., dog), or subordinate (e.g., Collie) names. This included an overall advantage for living objects! Her object naming, although not as markedly improved as her matching, similarly failed to show a category-specific impairment. These results suggest spontaneous recovery from a category-specific visual agnosia for living objects.
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Poster Session 2/8:00 a.m.–12:45 p.m.

PSYCHIATRIC NEUROPSYCHOLOGY

H. PICASSO, J. ALBA, R. HIDALGO, F. OSTROSKY-SOLIS, & M. BOBES. Evoked Related Potentials and Schizophrenia: P300 and N400.
Semantic disturbances have been considered a hallmark of schizophrenia. One line of research suggests that the spread of activation within semantic networks is enhanced, or disinhibited, in schizophrenia. A recent study found large priming in schizophrenics and extended the results to indirect priming (from "death" to "wood" via "coffin"). This implies that semantic activation spreads faster and wider in schizophrenics than in control subjects. In this study, even related potentials (ERP) N400 and P300 of schizophrenics were compared with those of control subjects in a picture semantic-matching task. Fifteen schizophrenic patients were recruited, all patients met DSM–IV and PANSS criteria. All patients were medicated at the time of ERP recordings. A control group of 15 subjects matched in age, education, and sex were used. The N400 latency was delayed in patients. Also, the amplitude of N400 in the different waveforms was reduced in schizophrenics; however, only congruent trials were different for patients (more negative) with respect to controls. This result is consistent with the hypothesis that schizophrenics use context poorly, but inconsistent with simple versions of the idea that associations are generally disinhibited in schizophrenia. Since the amplitudes of N400 and auditory P300 were not correlated, a general processing deficit does not explain the results. These findings are consistent with a previous study of schizophrenic patients in Cuba and China, and indicate that by using picture matching, a cross-cultural comparison and validation of N400 abnormalities can be made.
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T. HERLANDS, A. MEDALIA, & N. BARK. The Relationship Between Symptom Profile, Cognitive Impairment, and Abnormal Movements in a Group of Cognitively Impaired, Chronic, Hospitalized Patients With Schizophrenia.
Schizophrenia is associated with as many as 5 subtypes. At least 2 distinct subtypes are those presenting with predominantly positive symptoms (nondeficit) and those presenting with predominantly negative symptoms (deficit). Further investigation into the characteristics of these groups has found differences in the degree and type of cognitive impairment, the presence and degree of movement disorder and/or soft neurological signs, and outcome. Persons with deficit schizophrenia tend to be more cognitively impaired, tend to have more neurologic signs and symptoms, and tend to have poorer outcome (i.e., the inability to live independently) than those with the nondeficit subtype. The present study compared 60 cognitively impaired, chronic, hospitalized schizophrenic patients on cognitive measures of memory and problem-solving, symptom profile, and the presence and degree of movement disorder and soft neurological signs. Results supported previous findings, suggesting that patients with a negative symptom profile have greater cognitive impairment and have more soft neurological signs. This type of information supports the notion of schizophrenia subtypes. It further indicates that differences are present, even amongst the cognitively impaired and chronically ill, a group which might be thought of as homogenous. Fine-tuning our understanding of patient differences and schizophrenia subtypes will aid in targeting those patients most likely to fail in the community, and those who may respond to special therapeutic intervention, such as cognitive remediation.
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J. McCLOUGH. Neuropsychological Performance and Neurological Soft Signs in Schizophrenia.
The purpose of this study was to investigate the relationship between neurological soft signs and neuropsychological performance in patients with schizophrenia in order to address the issue of whether soft signs are related to global or more selective cognitive impairment. In addition, this study was undertaken in an effort to determine if the relationship between soft signs and neuropsychological performance is unique to schizophrenia. Thirty patients with DSM–IV diagnosis of schizophrenia and 30 patients with a DSM–IV diagnosis of bipolar I disorder were administered a comprehensive neuropsychological battery and underwent a standardized neurological examination. The results suggested that the neuropsychological tasks that discriminated schizophrenic patients with increased levels of neurological abnormalities were limited to those that involved motor speed, motor coordination, and to a lesser extent, frontal/executive func-

tions. These findings remained consistent even when lifetime medication exposure, extrapyramidal symptoms, and abnormal involuntary movements were taken into account. It is believed that the results of this study will provide additional empirical support for the hypothesis that soft signs may not be simply indications of diffuse and/or nonlocalizable neurological impairment, but rather might reflect a focal compromise of the frontal-subcortical circuitry of the brain. Schizophrenic patients who demonstrate more neurological soft signs may comprise a subset of schizophrenics whose neuropathophysiology involves more subcortical involvement compared to schizophrenics without evidence of neurological soft signs. It is believed that this study is an important step toward addressing and reducing the inherent neurobehavioral heterogeneity of schizophrenia.
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K.K. ZAKZANIS & D.A. YOUNG. The Effortful Encoding Hypothesis in Major Depressive Disorder: Evidence from a Clinical Sample.
A recent meta-analysis conducted by our research group found that of 22 studies of neurocognitive deficits in major depression, the greatest impairment occurred in tests of episodic declarative memory function. Moreover, we found depression to be accompanied by dysfunction of effortful encoding of information along with an accompanying inefficiency of retrieving poorly encoded information from declarative memory. As such, it was shown that patients with depression performed poorly on the RAVLT but not on the CVLT. The difference was thought to have occurred in keeping with semantic cluster processes that can be employed by those subjects completing the CVLT, but not the RAVLT. We did not see deficits on other measures of neuropsychological function that required demanding effort (e.g., the PASAT). Hence, we proposed that the effortful encoding hypothesis in major depressive disorder was specific to declarative memory and not an all-encompassing moderator of effect. Accordingly, we set out to test our hypothesis clinically by testing 20 patients with major depressive disorder and 20 normal healthy controls. Subjects were administered the RAVLT, CVLT, PASAT, brief measures of intelligence, and a depression scale. We found evidence to support our hypothesis where a dissociation between effect sizes computed between groups was found on the RAVLT and CVLT. We also found minimal effects on attention tasks requiring a great deal of effort for success (e.g., PASAT). Our findings suggest that effortful encoding difficulties are indeed specific to retrieval from declarative memory and not a characteristic finding across neuropsychological domains.
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M. GAROLERA, E. HUGUÉ, I. De MARIA, E. TRULL, B.M. PARDO, V. VALLÈS, L. DELGADO, & J. ALBERNI. Longitudinal Study: Executive Functions and Memory in First-Episode Schizophrenia.
Recent longitudinal studies about the course of cognitive deficits in schizophrenia suggest stability rather than a decline of neuropsychological functions. Some studies grouped variables into ability areas. *Objective:* to determine the course of cognitive performance 1 year after the onset of schizophrenia, attending molecular variables concerning memory and executive functions. Twenty-seven first-episode schizophrenic patients (20 male, 7 female; age 24.8 ± 6.3 years; 10 ± 2.5 years of education) completed neuropsychological tests (WMS–R, WCST, FAS, TMT–B) and were clinically assessed (PANSS) after 6 weeks of neuroleptic treatment. Subjects were reassessed after 1 year. At follow-up significant changes (p = .018) in clinical scores were found only in general psychopathology PANSS (baseline score: M = 30.3 ± 9.0; follow-up scores: M = 24.8 ± 6.2). The performance on some functions improved after 1 year: WCST (percentage of perseverative responses p = .01); FAS p = .006; WMS–R (Information and orientation p = .005; Mental Control p = .01; Logical Memory I, II p = .01; Verbal Paired Associates II p = .002). All variables were then grouped in 2 ability domains: differences became less significant (p = .02) in the executive domain and nonsignificant in the learning domain. These differences were not related to clinical variables. Our results suggest that most neuropsychological functions remain stable in early stages of schizophrenia, and some of them may improve in treated patients.
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L. GIOVANNI, P.J. MOBERG, L. HARPER MOZLEY, S.E. ARNOLD, W. BILKER, & R.E. GUR. Clock Drawing in Elderly Patients with Schizophrenia and Healthy Controls.
While clock drawing ability has been examined in patients with dementia, there has been little investigation of these skills in elderly patients with schizophrenia. Clock drawing abilities were assessed in 21 elderly patients with schizophrenia and 21 healthy elderly volunteers using the Clock Drawing Test (CDT) from the Boston Parietal Lobe battery. We also sought to assess how deficits in clock drawing relate to neuropsychological functions and activities of daily living. Neuropsychological abilities were assessed with a modified version of the Centers to Establish a Registry for Alzheimer's Disease (CERAD) cognitive battery. The Psychogeriatric Dependency Rating Scale (PGDRS) was used to assess general activities of daily living for the patient group. Patients with schizophrenia performed significantly worse relative to controls on the CDT. Further analysis of CDT performance revealed greater levels of impairment in the sequencing and reproduction of the internal details of the clock (e.g., placement and sequencing of the numbers and clock hands) as opposed to the reproduction of the general gestalt of the clock face. In patients, presence and placement of the clock hands was significantly correlated with their performance on other neuropsychological measures in addition to their overall orientation level on ADL ratings from the PGDRS. Similar to findings of clock drawing deficits in patients with dementia, elderly patients with schizophrenia also show significant deficits in their ability to generate and draw a clock. While basic visual-perceptual skills do seem important to this ability, strong associations with memory and semantic tasks also argue for contributions from other brain regions as well.
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M. KURTZ, P.J. MOBERG, R.C. GUR, & R.E. GUR. Remediation of Wisconsin Card Sorting Test Performance in Patients with Schizophrenia: A Meta-Analysis.
There has been growing interest in the development of behavioral remediation treatment strategies for the neurocognitive deficits characteristic of schizophrenia. One of the most common approaches to remediation over the past 15 years has been training on the Wisconsin Card Sorting Test (Berg, 1948). While an initial report suggested that performance on the WCST was not modifiable through enhanced instructions (e.g., Goldberg et al., 1987), many subsequent studies have revealed that, with appropriate task instruction, there is improvement on a variety of dependent variables associated with this task (e.g., Bellack et al., 1990). The uniformity of test selection, as well as the number of published reports (13) in this research area, suggested that meta-analytic evaluation of this portion of the remediation literature would facilitate findings across research studies. Results of the investigation revealed that composite effect sizes for intervention on the WCST across all 3 dependent variables (Categories, Perseverative Errors, Conceptual Level Responses) were large ($d+$ = .98, 95% CI = .80/1.16) for these studies. This effect was consistent across studies [$Q(20)$ = 17.6, p = .61] suggesting that any variations in the intervention applied, or WCST variable examined, did not influence the magnitude or consistency of the effect. Consistent with the overall analysis, no significant differences were seen between WCST variable types [$Q_b(2)$ = .79, p = .68]. The significance of these results for the development of more refined behavior treatment strategies will be discussed.
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J.S. BEDWELL, M. SHALANGO, G. STRAUSS, & L.S. MILLER. Accelerated Age-Related Decline of Visual Perception in Schizophrenia.
Previous research has indicated that relatives of persons with schizophrenia display reduced performance on tasks of visual processing. Additional research has indicated that persons with schizophrenia evidence an accelerated age-related decline on a specific task of visual perception, but to the authors' knowledge, no research has examined this effect in first-degree relatives—which would rule out potential confounds present when examining persons with schizophrenia directly. This study contributes to the gap in the literature and provides preliminary data from a larger ongoing study. Several computer tasks were administered to an initial sample of 23 first-degree relatives of persons with schizophrenia/schizoaffective disorder and 18 controls. The groups were well matched on age (controls: M = 49.5, SD = 12.92, range 30–75; relatives: M = 51.0, SD = 11.6, range 30–72; t = .393, p = .70), but differed on socioeconomic status, IQ estimate, and visual acuity. However, there was no indication of difference between groups in the relation of age to visual acuity (controls: R^2 = .09; relatives: R^2 = .06). Based on performance from conditions on 2 computer tests that required intense visual processing (Backward Masking and Span of Apprehension) a single summary score was created to represent accuracy. Although both groups displayed decreasing accuracy with increasing age, the data suggested that the relatives displayed an accelerated age-related decline (controls: R^2 = .20, relatives: R^2 = .63, z = 1.73, p = .07), which may reflect the influence of genes unique to schizophrenia on brain functioning. This finding supports previous research reporting a similar age-related decline in persons with schizophrenia and extends the finding to include healthy first-degree relatives.
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M. PÉREZ-GÓMEZ, I. BAEZA, S. CAÑIZARES, M. SALAMERO, M. BERNARDO, & C. JUNQUÉ. The Effect of Risperidone on Frontal Functions in First-Episode Schizophrenia.
Objective: To study the impact of the atypical antipsychotic risperidone on frontal functions in neuroleptic-naive first-episode schizophrenic patients. *Method:* Subjects: 26 neuroleptic-naive first episode schizophrenic patients (14 male, 12 female) were recruited from the Acute Psychiatric Ward of the Hospital Clinic i Provincial de Barcelona. They were compared with 16 healthy control subjects (matched for gender, age and education). *Procedure:* We assessed frontal functions with the following neuropsychological tasks: Trail Making Test B (TMT B), Continuous Performance Test (CPT), The Stroop Test, Tower of Hanoi, and Controlled Oral Word Association (COWA). Patients were tested before and one month after initiation of risperidone treatment. Healthy subjects were assessed at baseline and one month later to control practice effects on cognitive tests. *Statistical Analysis:* Multivariate analysis of variance for repeated measures for the frontal battery were performed to compare the results at baseline and one month after assessment. Groups were also compared at baseline by mean analyses (T-test, U-Mann-Whitney). *Results:* There were significative differences between patients and controls in the CPT, Stroop task, Trail Making B, and Tower of Hanoi at baseline. When comparison test–retests were made there was a significant difference in the Tower of Hanoi and COWA. *Conclusions:* Patients differed from control subjects in attentional tasks and executive functions at baseline. Before and after treatment there were differences in frontal functions: planning and verbal fluency.
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J. POOLE, H. WILLIAMS, M. FISHER, & S. VINOGRADOV. The Relation of Schizophrenic Patients' Coping Strategies to Neuropsychological Functioning, Symptom Severity, and Illness Outcome.
The Coping Response Inventory (CRI) is a measure of coping strategies that individuals employ to deal with stressful life events. It has been extensively used to evaluate patients with general medical conditions, substance abuse, and mood disorders, but not those with psychotic disorders. We administered the CRI to 88 clinically stable schizophrenic outpatients, to investigate whether patients' coping strategies are related to the neurocognitive and symptomatic expressions of their illness, as well as to clinical outcome. Compared to normative values, we found that schizophrenic subjects used significantly fewer proactive coping strategies (i.e., logical analysis, seeking help, positive-reframing, trying alternate solutions) and used significantly more avoidant strategies (emotional outbursts, resignation, avoidant thinking). Use of proactive coping strategies was associated with better performance on several cognitive measures (e.g., executive problem solving, facial affect recognition); use of avoidant strategies was associated with poor performance on other measures (e.g., visuospatial abilities). The strongest correlates of avoidant strategies, however, were patients' symptoms (notably, dysphoric mood and psychosis). In terms of outcome, greater use of proactive strategies and less use of avoidant strategies were associated with higher quality of life (socially and intrapsychically) and less frequent psychiatric hospitalization. This study suggests that the CRI can be a valuable adjunct to the comprehensive neuropsychological evaluation. Our findings highlight the relation of schizophrenic patients' proactive coping strategies to their neuropsychological resources, the relation of their avoidant strategies to unresolved symptoms, and the relation of both types of strategies to patients' quality of life and illness outcome.
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R.E. HARLAND, R. KRIKORIAN, P.K. SHEAR, & S.M. STRAKOWSKI. Cognitive Flexibility and Psychiatric Symptomatology in Different Domains of Psychosocial Functioning in Individuals with Schizophrenia.
Individuals with schizophrenia often experience significant impairment in autonomous living, occupational functioning, and social functioning, and both psychiatric symptoms and cognitive deficits predict these aspects of functioning. However, the extent to which each of these factors contributes to functional disability remains unclear. The purpose of this study was to determine the extent to which cognitive inflexibility, an executive function deficit observed in schizophrenia, contributed to specific domains of psychosocial functioning. Thirty-eight community-dwelling individuals (23 females, 15 males, M age = 42.3, SD = 7.7) with SCID-I/P diagnoses of schizophrenia were evaluated. Participants' psychotic, disorganized, and negative symptoms were rated formally using the SAPS and the SANS. Autonomous living, occupational functioning, and social functioning were rated using the Role Functioning Scale. The number of perseverative errors derived from the Wisconsin Card Sorting Test (WCST) was used as an index of mental flexibility. Bivariate correlations revealed that both the WCST and symptomatology were significantly related to autonomous living, occupational function, and social function. Partial correlations revealed that the WCST accounted for unique variance in autonomous living, while symptomatology was not significant after WCST was controlled. In contrast, symptomatology accounted for unique variance in both occupational function and social function once the WCST was partialed out, while the WCST was not a significant independent predictor. These results suggest that the predictive utility of cognitive functioning and symptomatology may differ as a function of the specific psychosocial skills examined. In particular, autonomous functioning appears to require greater cognitive flexibility than other aspects of functioning.
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E. CHEN, R. CHAN, P. CHAN, P. KWONG, & R. CHEN. Comparison of Short-Term Clinical and Neurocognitive Outcome Between Atypical and Typical Antipsychotics in First Episode Schizophrenia.
Treatment with atypical antipsychotics for patients with schizophrenia has been shown to have a beneficial effect on psychotic symptoms as well as a minimization of the medication side-effect profile. However, its effects for negative symptoms and neurocognitive impairments have not been consistently reported. The purpose of this study was to compare the short-

term clinical and neurocognitive outcome between the first episode schizophrenic patients treated with atypical antipsychotic risperidone and those treated with conventional antipsychotic haloperidol in a randomized open-label trial design. A total of 49 patients (29 patients in the risperidone group and 20 patients in the haloperidol group) were recruited. The Positive and Negative Symptoms Scale and High Royds Evaluation of Negativity Scale were used to assess psychotic symptoms. Neurocognitive function tests on attention, memory, and executive function were administered to patients upon admission and discharge. Medication side-effect and drop-out rate were also assessed. Despite the significant improvement of psychotic symptoms in both groups across the trial periods, risperidone did not demonstrate superiority in reduction of psychotic symptoms as well as medication side-effect profile as compared to haloperidol. However, patients in the risperidone group tended to show improvement in the Modified Wisconsin Card Sorting Test. The results indicate that positive symptomatic outcome is very good for first episode schizophrenia, whether treated with haloperidol or risperidone. Negative symptoms improved significantly but not completely in either group. Even though risperidone was used in a short-term treatment, it tends to improve general cognitive impairments in first episode schizophrenic patients as compared to haloperidol.
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K.E. WILDER-WILLIS, P.K. SHEAR, R.M. STUTZ, & S.M. STRAKOWSKI. Cognitive Correlates of Psychosocial Outcome in Bipolar Disorder.
A subgroup of individuals with bipolar disorder (BPD) experience difficulties in psychosocial functioning during periods of clinical stability. BPD is also associated with impairment in memory and executive functioning. The goal of the current study was to determine whether executive functioning and memory were associated with difficulties in primary role (e.g., ability to carry out responsibilities associated with work, school, or housework) and relationship functioning (e.g., ability to form close relationships) in euthymic patients with BPD. Twenty-four clinically stable individuals with BPD (M age = 30, SD = 7) participated in the study and were administered tests of executive functioning [Wisconsin Card Sorting Test (WCST), Trail-Making test (TMT)], verbal memory [California Verbal Memory Test (CVLT)], and visual spatial memory and constructional ability [Benton Visual Retention Test (BVRT)]. Psychosocial functioning and clinical stability were assessed with the Longitudinal Interview Follow-up Evaluation (LIFE) and the presence of depressive, manic, and psychotic symptoms were assessed with the Hamilton Depression Scale (HAM–D), Young Mania Rating Scale (YMRS), and Scale for the Assessment of Positive Symptoms (SAPS), respectively. Recognition memory ($p < .01$) and visual-spatial constructional skills ($p < .01$) made significant, independent contributions to primary role functioning after controlling for the effects of demographic and clinical variables. Sequencing skills made a significant and independent contribution to relationship functioning after controlling for the effects of demographic and clinical variables ($p < .04$). The findings suggest that executive functioning and memory contribute to deficient psychosocial functioning in euthymic patients with BPD.
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G.E. GETZ, M. STEED, K.E. WILDER-WILLIS, M.E. ZIMMERMAN, K. BATES-COREY, A. J. JAK, P.K. SHEAR, & S.M. STRAKOWSKI. Nonverbal Memory Impairment in Mania and Euthymia.
Recent research has indicated that individuals with bipolar disorder (BPD) exhibit cognitive dysfunction, which appears to persist in approximately one-third of patients even during euthymia. We have reported that manic patients exhibit nonverbal memory impairment, including perseverative errors, in the context of spared visuospatial perception and construction. The goal of the present study was to re-examine data for the manic sample, this time including a euthymic comparison group, to determine if nonverbal memory deficits are specific to periods of abnormal mood. Thirty healthy participants, 36 manic patients with BPD, and 24 patients with BPD in remission were administered the Benton Visual Retention Test (BVRT) as part of a comprehensive neuropsychological battery. In the recall condition, after covarying for the copy condition, there were significant group differences in errors ($p < .05$) and correct designs ($p < .05$). The manic patients performed worse than the healthy volunteers ($p < .02$ for both scores). The euthymic patients performed comparably to the manic ($p > .27$ for both scores) as well as the control groups ($p > .17$ for both scores). Further, the manic patients made more perseverations ($p < .003$) and rotations ($p < .05$) than the control group. The euthymic patients also made significantly more perseverations ($p < .04$) than the control group, but there were no significant differences between euthymic and manic patients on any error type ($p > .13$ for all cases). This study indicates that patients with BPD, even while in remission, demonstrate subtle nonverbal memory impairment.
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D. MATTHEWS & L. FISHER. Pathological Apathy With Episodic Explosiveness: A Case Study.
Pathological apathy is sometimes referred to as "subcortical dementia," "pseudodepression," the "indifference reaction," or the "lateral frontal convexity syndrome." It is a neuropsychiatric syndrome seen in cerebral vascular disorders or neoplastic lesions, characterized by lack of initiative, poor spontaneity, flat effect, decreased motivation, and lack of interest in usual activities. There may be unusual cheerfulness and anosognosia. In some cases, there may be some associated depression, but the loss of drive and ambition and lack of concern over these dramatic changes is not due to a depressive disorder. Lesions of the right frontal convexity, right temporal lobe, or posterior internal capsule can produce this type of pathological apathy. The present case study presents a 28-year-old male patient who suffered polysubstance-induced lesions in frontal and temporal regions detected by neurophysiological abnormalities. Cortical functions including basic intellect, language, and perceptual motor skills were intact but he was severely disabled by chronic apathy. He had been a college student, athlete, and musician, but subsequently was no longer capable of living or working independently. Diagnostic test results and treatment plans will be reviewed for this classic case of pathological apathy.
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K.D. HIATT, A.R. LORENZ, & J.P. NEWMAN. Lateralized Information-Processing Deficits in Psychopathic Offenders.
Psychopaths demonstrate failures using emotional information and inhibitory threat cues. These performance deficits may be related to poor coordination of left- and right-hemisphere processing resources (Hare, 1998; Hiatt, Lorenz, & Newman, 2001), and may be particularly evident under conditions that primarily activate the left hemisphere (Bernstein, Newman, Wallace, & Luh, 2000; Kosson, 1998). Experiment 1 assessed emotion facilitation in 31 psychopaths and 43 controls while they performed a lexical decision task that differentially activated the left and right hemispheres by requiring either right- or left-handed responses. Experiment 2 examined the performance of 9 psychopaths and 41 controls on a passive avoidance task in which the go/no-go stimuli were presented unpredictably on either the left or the right side of the monitor and all responses were made with the right hand. In Experiment 1, a significant Psychopathy × Response Hand interaction [$F(1,72) = 4.00$, $p < .05$] indicated that psychopaths displayed normal emotion facilitation when responding with the left hand, but nonsignificant facilitation when responding with the right hand. In Experiment 2, a significant Psychopathy × Side interaction [$F(1,48) = 5.01$, $p < .05$] revealed that psychopaths' ability to discriminate between go- and no-go cues was significantly worse for stimuli on the left as opposed to the right side of the monitor. As the right hemisphere processes both emotional and left visual field information, these studies suggest that psychopaths' performance abnormalities may be related to

poor utilization of right-hemisphere processing under conditions that preferentially activate the left hemisphere.
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K.B. COREY, K.E. WILDER-WILLIS, P.K. SHEAR, & S.M. STRAKOWSKI. Illness Insight, Cognitive Complaints, and Executive Functioning in Bipolar Disorder.
Lack of insight is a common clinical barrier when treating patients with major psychiatric illness. Poor insight is a hallmark symptom of mania, with patients often denying the need to be hospitalized despite marked social and occupational impairment. Little is known, however, about the nature of insight in patients with bipolar disorder who are no longer experiencing a mood episode. In addition, very little is known about the degree to which patients demonstrate an awareness of their cognitive deficits. The present study examined the relationship between insight, self-reported cognitive complaints, and performance on executive functioning tasks in a young, nonchronic sample of euthymic participants with bipolar disorder. Insight and neurocognitive deficits were observed in approximately 30% of euthymic patients; however, the primary hypothesis that insight would be associated with deficits in executive functioning was not supported. Shorter duration of illness (rho $= -.49$, $p < .01$), medication noncompliance ($z = 3.24$, $p < .0002$), and current substance use ($z = -2.22$, $p < .04$), were associated with deficits in insight. The second hypothesis of the study that insight would be related to self-reported cognitive complaints was supported (rho $= .54$, $p < .007$). This relationship suggests that participants who had poor insight into their illness were also less likely to endorse difficulties in their cognitive functioning.
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E. LARSON, R. KRIKORIAN, P.K. SHEAR, & S. STRAKOWSKI. Executive Function and Mood State in Bipolar Disorder.
Bipolar disorder (BPD) is a psychiatric illness characterized by episodes of abnormal mood elevation. Recently, investigators have begun to systematically investigate the cognitive sequelae of this disorder. Deficits in executive functioning, a term referring to a number of interrelated cognitive skills that are critical for regulating behavior, have been reported especially while patients are manic. Several previous studies used complex tests of executive ability, making it difficult to determine which component executive abilities were impaired. In the present study, tests were selected to evaluate 2 specific aspects of executive function thought to be associated with the clinical pathology of BPD. The object alternation task (OA) was administered as a measure of inhibitory control and the delayed response task (DR) as a measure of spatial delayed working memory. Participants included 15 patients with BPD who were manic, 18 patients with BPD who were euthymic, and 18 healthy controls. With age and verbal IQ included as covariates, a repeated measures ANCOVA revealed a significant interaction between group and task, $F(2,48) = 3.5$, $p = .04$. *Post-hoc* tests revealed that, although there were no significant group differences on the DR, manic, $F(1,31) = 5.7$, $p = .02$, and euthymic, $F(1,34) = 6.6$, $p = .02$, patients performed significantly worse on the OA than on the DR. The manic, $F(1,29) = 8.5$, $p = .01$, and euthymic patients, $F(1,32) = 4.1$, $p = .05$, performed worse than healthy controls on the OA, but were not different from each other. These results suggest relatively normal spatial working memory abilities in BPD patients, in the presence of deficient inhibitory control, which was evident across mood states.
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P.K. SHEAR, M.P. DELBELLO, H.L. ROSENBERG, & S.M. STRAKOWSKI. Parent Ratings of Executive Functioning in Adolescents With Bipolar Disorder.
Bipolar disorder (BPD) is a serious mental illness with a lifetime prevalence of approximately 1.2% in children between 9 and 16 years of age. In adults, BPD is associated with cognitive deficits, including executive dysfunction; however, little is known about cognitive ability in children and adolescents with the disorder. It is also unclear to what degree the comorbid ADHD that these patients commonly exhibit affects their everyday functioning. In this study, we examined the abilities of 29 adolescents with BPD (ages 12 to 18 years) to perform everyday behaviors thought to be dependent on executive functioning abilities, as reflected in ratings on the Behavior Rating Inventory of Executive Functioning (BRIEF) made by a parent or grandparent. Each of the adolescents with BPD, including a subgroup without comorbid ADHD, received scores on the BRIEF that fell well within the clinically impaired range in comparison with published normative data. Adolescents with BPD + ADHD received ratings that did not differ significantly from those with BPD alone on metacognitive functions (e.g., initiation and self-monitoring). In contrast, those with BPD + ADHD showed significantly more pronounced regulatory dysfunction (e.g., set shifting and inhibitory control) than those with only BPD ($p < .007$). These results suggest that adolescents with BPD experience clinically significant functional impairment that may be related to executive dysfunction, and also that comorbidity may affect the specific pattern of functional deficit.
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R. HATFIELD, I. SMET, T. MOONEY, D. MAIXNER, & S. BERENT. Verbal and Visuospatial Memory in Patients with Major Depressive Disorder.
Despite a wealth of literature associating both primary left cortical involvement and memory impairment with major depressive disorder (MDD), few studies have investigated whether lateralized memory deficits occur in patients with MDD. We compared the verbal and visuospatial memory functioning of 27 patients (M age = 60) who met DSM–IV criteria for major depression. All patients were hospitalized at the time of evaluation, free of known major medical problems, medication refractory, and awaiting the initiation of electroconvulsive therapy. Patients were administered a battery of neuropsychological tests prior to the onset of ECT that included measures of general mentation, intellect, memory, attention, language, executive processing, motor abilities, and mood state. Results were adjusted for age, education, and gender effects where appropriate. Individual task performance was referenced to normative based standard scores. Within subject comparisons of performance on the California Verbal Learning Test (CVLT) and Rey Complex Figure Test (RCFT) revealed no significant differences on immediate recall ($p = .602$) or delayed recall ($p = .184$). In addition, recognition memory scores were as impaired as immediate and delayed recall scores for both the CVLT and RCFT with most scores falling in the borderline impaired range. This study suggests that memory impairment in individuals with MDD is likely related to factors other than focal organic dysfunction alone.
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J. COSCIA, M.D. RIS, B. HUTH, & D. GILBERT. Inhibitory Control and Psychopathology: Evidence From Tourette's Syndrome.
Dysfunctional inhibitory processes have been hypothesized to underlie many forms of developmental psychopathology. This study evaluated the relationship between inhibitory control and 2 dimensions of psychopathology, internalizing and externalizing behavior, in children with Tourette's syndrome (TS). Neuropsychological data from 20 children (M age = 10.7; range 7–17) with TS referred for evaluation of learning or behavioral difficulties were analyzed. Thirteen children (65%) had comorbid conditions (TS + ADHD = 11; TS + OCD = 1; TS + ADHD + OCD = 1). Children performed in the average range on measures of intellectual ability and academic achievement. Behavioral inhibitory deficits were measured by number of commission errors on the Connor's Continuous Performance Test (CPT) and psychopathology was assessed with the Be-

havioral Assessment Scale for Children (BASC) Parent Version. Number of commission errors was significantly associated ($p < .05$) with parent ratings of hyperactivity and conduct problems (r's = .48 and .48). Significant associations were not found between commission errors and parent ratings of depression and anxiety (r's = −.20 and −.03). These findings suggest that children with high levels of externalizing behavior have impaired inhibitory processes. However, these findings do not support a link between high levels of internalizing behavior and enhanced inhibitory control.

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B. LEBOWITZ, M. STEED, K. BATES-COREY, K. WILDER-WILLIS, P.K. SHEAR, & S. STRAKOWSKI. Premorbid IQ Estimation in Mania.

During episodes of mania, individuals with bipolar disorder (BPD) exhibit a variety of neuropsychological deficits. Because of the importance of premorbid IQ estimation for the interpretation of neuropsychological test performance, an IQ assessment instrument resilient to the cognitive influence of acute psychiatric symptoms is desirable. In this preliminary study, we suggest that the American modification of the National Adult Reading Test (ANART) reliably estimates premorbid IQ even in the presence of marked affective symptoms. We administered the ANART to a sample of 9 inpatients (5 females, 4 males, average age = 27.1, $SD = 4.1$) who were experiencing an acute episode of mania (average Young Mania Rating Scale = 14.6, $SD = 8.2$). During a subsequent follow-up visit after the individual's manic symptoms had remitted (average Young Mania Rating Score, Mean = 2.6, $SD = 3.0$), the ANART was readministered. Descriptive analyses found the group mean IQ while manic was 106.00 and was 106.80 when the participants were euthymic. A Wilcoxon signed ranks test was performed, revealing no significant difference between groups ($z = -1.47$, $p > .14$). Finally, no individual's score varied by more than 2 points across the 2 testing sessions. These results suggest that the ANART is a reliable indicator of premorbid IQ in manic patients.

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E. TWAMLEY & M. STEIN. Are College Students with PTSD Neuropsychologically Impaired?

The pathways linking traumatic experience and cognitive impairment are not fully understood, but stress is known to elicit functional and/or structural cerebral changes. Some studies suggest that individuals with posttraumatic stress disorder (PTSD) exhibit neuropsychological deficits (e.g., executive dysfunction, memory impairment), but other studies have found no neuropsychological differences between PTSD patients and normal comparison subjects (NCs). Furthermore, whether cognitive impairment is due to PTSD, comorbid illness, or trauma exposure itself is unclear. To reduce the potential confound of comorbidity, we examined cognitive performance in 3, nonpatient undergraduate groups: 25 students exposed to trauma who met criteria for PTSD (PTSD+), 33 exposed to significant psychological trauma, but without PTSD (PTSD−), and 34 NCs without trauma exposure. A brief neuropsychological battery emphasizing frontal-executive functions was administered. We hypothesized that the NCs would perform better than the PTSD− group, who would in turn perform better than the PTSD+ group. Contrary to expectation, ANOVA tests revealed no between-group differences on measures of verbal fluency, Trailmaking Tests, Digit Vigilance, or Letter-Number Sequencing. Moreover, PTSD+ students performed better than NCs on forward and backward Digit Span ($F = 4.9$, $p < .01$; $F = 3.6$, $p < .05$). On the Wisconsin Card Sorting Test (WCST), PTSD− students performed better than NCs in terms of learning efficiency ($F = 3.2$, $p < .05$). The only predicted pattern of performance we found was on WCST failure to maintain set ($F = 7.1$, $p < .001$; NC < PTSD− < PTSD+). These results suggest that college students with trauma exposure, regardless of PTSD status, do not exhibit marked neuropsychological impairments, but may instead represent a "cognitively resilient" group.

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A. GREGORY, J. MURPHY, M. SEMRUD-CLIKEMAN, C. CARLSON, & D. TUCKER. Orbitofrontal and Dorsolateral Neuropsychological Functioning in Adolescent Psychopathy.

Psychopathic personality disorder typically involves impulsivity, lack of empathy, poor anger control, aggressive and antisocial behavior as well as grandiosity and superficial charm. These characteristics are often exhibited in patients with orbitofrontal brain damage. We recruited 44 boys aged 12 to 17 (25 from a residential psychiatric treatment facility and 19 from the community) to test the hypothesis that psychopathic characteristics are associated with orbitofrontal neuropsychological deficits. Treatment center and community participants were matched for age and socioeconomic status. Participants completed the Psychopathy Checklist-Youth Version and neuropsychological tests assessing orbitofrontal and dorsolateral prefrontal cortex functioning. Results of a canonical regression analysis revealed that psychopathy was not associated with orbitofrontal neuropsychological test performance (smell identification, Porteus Maze qualitative errors, Go/No Go commission errors, and verbal inhibition deficits) when these tests were grouped together. Follow-up exploratory correlations did reveal an association between psychopathy and verbal inhibition deficits ($r = .31$, $p < .02$). Canonical regression showed that psychopathy was associated with poorer performance on dorsolateral prefrontal neuropsychological measures (WCST perseverative errors and verbal fluency impairment). Follow-up analyses revealed that psychopathy was highly associated with WCST perseverative errors ($p < .005$) and to a lesser degree associated with verbal fluency deficits ($p < .05$). Psychopathy was also associated with lower IQ based on prorated Block Design and Vocabulary Scores. These results suggest that adolescent psychopathic characteristics are associated with prefrontal brain dysfunction involving verbal disinhibition, nonverbal perseveration, and verbal fluency deficits, as well as lower IQ (based on vocabulary and visuospatial motor abilities).

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S.K. MILLER & D.S. KOSSON. Global–Local Processing in Non-Right Handed Prison Inmates.

The left hemisphere activation hypothesis of psychopathy posits that psychopaths have difficulties processing information in situations that place substantial demands on left hemisphere resources (Kosson, 1998). One paradigm used to corroborate this hypothesis involves global–local processing, which requires right *versus* left hemisphere resources, respectively, in healthy right handers (Van Kleeck, 1989). Right handed psychopaths have demonstrated deficits in global–local processing when demands are placed on the left hemisphere (Byrnes et al., 2001). The extent to which this pattern holds in non-right handed psychopaths, where brain lateralization is more variable, has yet to be adequately studied. Therefore, the present study was designed to explore the extent to which handedness differences affect psychopaths' global–local processing. Participants were 31 non-right handed prison inmates from the Lake County Jail in Illinois (13 psychopaths and 18 controls). Inmates were required to identify targets at both global and local levels during 3 blocks where targets appeared at the local level 80% (local bias), 50% (no bias), or 20% (global bias) of the time. In contrast to previously analyzed right handers (Byrnes et al., 2001), non-right handed psychopaths in the present study did not show a pattern of left hemisphere deficits. Like controls, non-right handed psychopaths responded to local targets faster under local bias conditions than under neutral conditions. In addition, non-right handed psychopaths did not show deficits when processing global or local stimuli

under local bias conditions. Implications for the neuropsychology of psychopathy are discussed.
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Paper Session 3/9:00–10:45 a.m.

AGING

P. EBERT & H. TUOKKO. Demographic Influences on Cognitive Abilities: The Canadian Study of Health and Aging.
Few of the many cross-sectional and longitudinal studies of cognitive aging involve a thorough examination of measures typically used in clinical practice for identifying cognitive impairment in older adults. We examined data for 308 persons over age 64 with no cognitive impairment from the Canadian Study of Health and Aging who were administered neuropsychological measures including: Buschke Cued Recall, Rey Auditory Verbal Learning Test (RAVLT), Benton Visual Retention Test–Recognition (BVRT–R), selected WAIS–Revised subtests, Verbal and Semantic Fluency. Participants were grouped according to age (65–74, 75–84, 85+ years) and education (0–9, 10–14, and 15+ years). Participants were reassessed 5 years later. Test results were analyzed using one-way ANOVA for cross-sectional data and repeated-measures ANOVA for longitudinal data. Cross-sectional analysis demonstrated decline with age ($p < .001$) for a variety of memory (e.g., RAVLT Total Recall) and speeded tasks (e.g., Digit Symbol). In addition, higher performance with higher education ($p < .001$) was demonstrated on several tasks such as RAVLT Total Recall, BVRT–R, Comprehension, Semantic and Verbal Fluency, Block Design, and processing speed. In contrast, longitudinal analysis revealed declining performance with age ($p < .001$) on the following tasks: Buschke Delayed Recall and Digit Symbol. Longitudinal and cross-sectional analysis of demographic influences can yield very different results. Longitudinal analysis indicates that processing speed and delayed memory decline with age.
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H. TUOKKO & R. J. FRERICHS. A Comparison of Conventional and Robust Normative Samples: Implications for Practice.
The accurate interpretation of neuropsychological test scores requires the use of appropriate normative data sets. This is particularly true for older adults given the increasing importance of detecting subtle, early manifestations of an evolving dementia. To distinguish between normal and pathological cognitive aging, it is necessary to take into consideration a variety of factors including age, education, gender. It is also important to remove the contamination bias that results from the inclusion of individuals with incipient dementia (Sliwinski et al., 1996). We examined the effects of this contamination with longitudinal data from the Canadian Study of Health and Aging (CSHA), a nationwide epidemiological study of dementia. Persons with no cognitive impairment at CSHA-1 comprised the conventional normative sample and those who took part in CSHA-2, 5 years later, and continued to show no cognitive impairment comprised the robust normative sample. Comparisons of these samples revealed that the conventional sample showed lower means for all 12 measures examined and the effects of age were overestimated for some measures of memory and category fluency. Education and gender effects remained consistent across samples. Application of conventional and robust norms, adjusting for age, education, and gender, showed that the robust norms were more sensitive to poor test performances at CSHA-1 in people who were diagnosed with dementia at 5 year follow-up. The use of robust samples may redefine our understanding of normal cognitive aging and facilitate the identification of subtle cognitive disturbances in older adults.
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M.E. O'CONNELL, H. TUOKKO, & R. GRAVES. The Modified Mini-Mental State Exam (3MS): Implications of Correcting for Bias.
The predictive validity of a screening tool for cognitive impairment can be compromised when factors other than cognitive impairment influence scores. The Modified Mini Mental State Exam (3MS; Teng & Chui, 1987), a screening tool for cognitive impairment, is influenced by age and level of education (Tombaugh, McDowell, Kristjansson, & Hubley, 1996). Using data from the Canadian Study of Health and Aging (CSHA-1), a national epidemiological study of cognitive impairment in persons 65 years of age and older, a multiple regression analysis confirmed that age, education level, and gender influenced the screening 3MS scores. We removed these influences statistically using the regression weights to adjust the 3MS scores (3MS–ADJ) for each individual ($N = 8901$). The sensitivity and the specificity for distinguishing cognitively impaired from unimpaired persons were then computed for each possible cut-off. After correcting for the verification bias with Begg and Greenes's (1983) procedure, receiver operating characteristic plots were constructed and the areas under the curves (AUCs) were computed for the 3MS and the 3MS–ADJ. We found that the AUC for the 3MS–ADJ (.79) was significantly smaller than the AUC for the 3MS (.82; $z = 328$, $p < .001$). In conclusion, the use of simultaneous multiple regression to remove age, education, and gender influences on the 3MS scores resulted in significantly lower predictive validity than the original "biased" 3MS. Therefore, we recommend the use of the unadjusted 3MS scores when using the 3MS to screen for cognitive impairment.
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M. KITNER-TRIOLO, H. CRAWFORD, D. ARENBERG, & A. ZONDERMAN. Do Longitudinal Age Changes Mirror Cross-Sectional Differences in Reaction Time?
This study examined the convergence between cross-sectional age differences and longitudinal age changes in processing speed in cognitively normal elderly individuals. Processing speed changes, in addition to executive and memory declines, have been demonstrated as important in both normal (Schretlen, Pearlson et al., 2000) and pathological cognitive aging (Flicker, Ferris, & Reisberg, 1993). In fact, some propose that processing speed is the cause for most age-related cognitive decline (Salthouse, 1996). Depending on research design and type of processing speed task, cross-sectional age differences can either under- or over-estimate longitudinal age changes. We investigated whether 6-year longitudinal age changes in reaction time (RT) were similar to cross-sectional age differences. Participants were 656 nondemented community-dwelling Baltimore Longitudinal Study of Aging volunteers (baseline ages: 20–79 years old), free of medical diagnoses affecting RT performance (e.g., eye, brain, or musculoskeletal system diseases). Participants completed a simple RT task and 4 complex RT tasks varying in difficulty, initially and 6 years later. We examined both cross-sectional and longitudinal effects using a mixed model regression with sex and initial RT testing age as between subject factors, and RT tasks and time of testing as within subject factors. Cross-sectionally, men were faster than women for 2 RT tasks. The 2 oldest groups (52–61 and 62–79 years) were significantly slower than the 3 younger groups (20–31, 32–41, and 42–51 years). These differences were exacerbated as RT complexity increased. Longitudinally, only 62–79 year olds were significantly slower over 6 years. These findings indicate that cross-sectional RT over-estimated longitudinal RT.
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J. COOPER, B. HERMANN, M. SAGER, B. BELL, & A. WOODARD. Undetected Mild Cognitive Impairment in an Elderly General Medical Population.
Objective: This investigation sought to determine the rate of undetected mild cognitive impairment (MCI), an identified precursor condition of Alzheimer's disease (AD), in an elderly outpatient general medical popu-

lation. *Methods:* 100 adults aged 65 and over attending the outpatient General Internal Medicine and Geriatric Clinics at the University of Wisconsin Hospital were administered measures of memory and cognitive function. Administered tests included the Clock Draw Task, Rey Auditory Verbal Learning Test (AVLT), Dementia Rating Scale (DRS), CERAD neuropsychological battery, WRAT–3 Reading, and a depression screen (Geriatric Depression Scale). Spouses completed the Symptoms of Dementia Screen (SDS). Any subject with a pre-existing diagnosis of dementia, MCI, or neurological disease was excluded. MCI was defined in nondemented subjects by an age and education corrected (MOANS) AVLT long-term percent recall (LTPR) scales score of ≤ 7. *Results:* Undetected MCI was evident in 8% of the sample. A more conservative AVLT criterion (age/education corrected LTPR scaled score of ≤ 6), suggested a 5% rate of undetected MCI. Finally, an additional 9% of subjects exhibited significant cognitive impairments independent of MCI that were previously undetected/unreported. *Conclusions:* Mild cognitive impairment is present and undetected in a sizable minority of elderly outpatients attending general medical clinics.

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T. WARD. University of the West Indies Cognitive Assessment System, Validation and Norms.

Financial constraints within the Caribbean region make access to expensive resources such as complex test batteries difficult. The response to this problem at the University of the West Indies has been to develop a local battery which can be used for neuropsychological screening and which can be freely distributed. The University of the West Indies Cognitive Assessment System (UWICAS) consists of several tests of basic cognitive functions, including attention, vigilance, working memory (both verbal and visual) and long-term memory (both verbal and visual). There are 3 parallel versions, to allow repeat assessments. The set of tests included in the battery was inspired by the use of a similar battery for many years in psychopharmacology, suggesting that they are useful in the assessment of neurological disorders such as Alzheimer's disease. In addition, as far as possible, all the tests were designed to be language-free (with the exception of verbal long-term memory), to facilitate their use in the linguistically diverse Caribbean region. Normative data will be presented based upon the assessment of 156 volunteers, ranging in age from 18 to 76, across the 3 versions. In addition, a factor analysis was performed upon the data from the first assessment, which supports the suggested breakdown of cognitive functions assessed. It is our intention to freely distribute the system to any neuropsychologists wishing to use it in their work.

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J. MANLY, P. TOURADJI, D. JACOBS, S. SMALL, & Y. STERN. Acculturation, Bilingualism, and Cognitive Test Performance Among Hispanic Elders.

We examined the independent relationships of years in the U.S. and Spanish and English reading ability to cognitive test performance among elderly immigrants whose first language is Spanish. Participants were 20 Hispanics age 65 and older who reside in northern Manhattan. Elders were born and educated in the Caribbean (81%; Dominican Republic, Cuba, and Puerto Rico) or South and Central America. Participants were independently rated as nondemented and free of neurological/psychiatric disease based on a physician's examination. A comprehensive neuropsychological battery was administered in Spanish, as well as the Word Accentuation Test (WAT; a measure of Spanish reading skill) and the WRAT–3 Reading Recognition subtest. WRAT–3 score was significantly correlated with years in the U.S. ($r = .73$; $p < .001$) but not with WAT score ($r = .17$, $p = .47$). Multiple regression analyses revealed that after adjusting for age and years of education, elders with lower Spanish reading level obtained significantly lower scores on WAIS–R Similarities, letter fluency, and a figure matching test ($p < .05$ for all). Elders who had lived in the U.S. for longer obtained high scores on verbal list learning, figure memory, and figure matching ($p < .02$ for all). Elders with lower WRAT–III reading level obtained lower scores on a figure memory test ($sr^2 = .32$, $p = .003$). If years in the U.S. and English reading skill represent acculturation level among elderly Spanish-speaking immigrants, these preliminary results suggest that years in the U.S. is the more meaningful predictor of test performance.

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Paper Session 4/9:00–10:45 a.m.

MULTIPLE SCLEROSIS

J. LENGENFELDER, N.D. CHIARAVALLOTI, & J. DeLUCA. Identifying Working Memory Impairments in Multiple Sclerosis.

Individuals with multiple sclerosis (MS) have consistently demonstrated impairments in working memory (WM). However, the specific components of impaired WM (i.e., central executive *vs.* storage and maintenance) remain unclear. The present study sought to identify the source of this WM deficit through the administration of an auditory n-back task and the Paced Auditory Serial Addition Test (PASAT). The auditory n-back task assesses primarily storage and rehearsal/maintenance with 3 memory loads (1-back, 2-back, 3-back). The PASAT assesses storage and rehearsal/maintenance, but also has a significant central executive component. Subjects were 13 individuals with MS without cognitive impairment (MS−), 18 individuals with MS with cognitive impairment (MS+), and 17 healthy controls (HC). Results showed that MS+ subjects performed significantly worse than either MS− or HC on the PASAT ($p < .01$). There were no differences between groups on the 1-back or 3-back conditions of the auditory n-back task, however, MS+ subjects demonstrated impaired performance on the 2-back condition compared with both the MS− and HC groups ($p < .01$). Results suggest that central executive abilities are the primary difficulty for MS subjects. MS+ subjects also appear to have some difficulty with storage and rehearsal as memory load increases (i.e., 2-back). Results are discussed within the framework of Baddeley's model of working memory.

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G. J. CHELUNE. Prevalence and Estimated Risk of Processing Speed Deficits in Multiple Sclerosis.

Approximately 45–65% of MS patients manifest cognitive dysfunction, with processing speed deficits (PSD) being particularly common. Although group differences are often cited, there are few data concerning the actual prevalence of PSD in MS compared to the general population. To examine the prevalence and estimated risk of PSD, the performances of 105 patients with clinically definite MS were compared to the 2450 subjects in the WAIS–III standardization sample (SS). PSD was operationally defined as a Verbal Comprehension–Processing Speed Index discrepancy of ≥ 24 points. MS patients were further subdivided by clinical course during the year prior to evaluation, with 69 cases having relapsing/remitting (RR) courses and 39 having primary or secondary progressive (PG) courses. The MS groups had comparable mean VCI scores to the SS group, but lower PSI scores ($p < .000$). Estimated relative risk (ERR) of PSD was calculated by odds ratios. The ERR of PSD was 6.6 higher among the MS than the SS group (prevalence 26.7% *vs.* 5.2%). The risk was lower among patients with RR courses (ERR 3.1; prevalence of 14.5%), but especially high among patients with PG courses (ERR 18.3; prevalence of 50.0%). When the PG and RR groups were directly compared, PG patients were 5.9 times more likely to manifest PSD than patients with RR courses. These findings suggest that PSD are prevalent in MS and that operational definitions of PSD may be useful in defining cognitive end-

points for use in clinical trials and for defining changes in clinical course among patients with MS.
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N.D. CHIARAVALLOTI, F.G. HILLARY, J. DeLUCA, J.H. RICKER, W. LIU, & A. KALNIN. Cerebral Activation Patterns of Working Memory in Multiple Sclerosis Using fMRI.
This study examines brain activation patterns during performance of a working memory task in individuals with clinically definite multiple sclerosis, compared to healthy controls. Functional magnetic resonance imaging (fMRI) was performed on a 1.5 Tesla GE scanner to assess brain activation during a modification of the Paced Auditory Serial Addition Test (mPASAT). Participants were 5 MS subjects with working memory impairment evidenced on neuropsychological testing (MS+), 4 MS subjects without working memory impairment (MS−), and 5 healthy controls (HC). There were no significant differences between groups in age, education, or estimated premorbid IQ. Data were analyzed using Statistical Parametric Mapping (SPM99) software, with a stringent significance level (alpha $<$ .005, voxel extent $\geq$ 8). A random effects procedure identified significantly activated regions in each group, as well as differences between groups. Both MS groups and the HC group were able to perform the task, with no significant differences between groups in number of correct responses. Activation patterns within HC and MS− groups were noted in similar brain regions, consistent with published observations in healthy samples. That is, activations were lateralized to the left hemisphere, involving predominantly frontal regions. In contrast, activation patterns only within the MS+ were lateralized to the right hemisphere, involving homologous regions of the right frontal lobe, as well as the right parietal lobe. It therefore appears that working memory dysfunction in MS subjects is associated more with altered patterns of cerebral activation than that which is observed in healthy controls and MS subjects without working memory impairment.
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J.A. BOBHOLZ, S. DURGERIAN, J. ZAFEROS, D. MILLER, J. RAO, C. ELSINGER, E. MAAS, L. LOBECK, & S.M. RAO. Working Memory in Multiple Sclerosis: A fMRI Investigation.
Several behavioral studies have documented deficits in working memory performance in patients with multiple sclerosis (MS). Only recently have functional neuroimaging studies begun to examine the neural activation patterns associated with working memory dysfunction in MS. In this whole-brain functional MRI (fMRI) study, we compared MS patients (n = 20) and demographically-matched normal control (NC) subjects (n = 10) on the N-back task, a working memory measure that parametrically varies the extent of working memory load. In this task, subjects are presented a series of single letters and asked to respond if the current letter matches a letter presented either 1, 2, or 3 items earlier. In the control condition (0-back), subjects responded to the presentation of a specific predetermined letter. MS subjects also underwent FLAIR MR imaging to measure the extent of T2-weighted cerebral white matter lesions. Analysis of behavioral data revealed no significant performance differences between the MS and NC groups ($p > .05$) on any of the N-back conditions. However, fMRI results revealed significant group differences on activation maps, particularly during the 3-back condition, which required the greatest working memory load. Compared to NC subjects, MS patients showed significantly greater activation in the left posterior superior and middle temporal, left posterior insular, and right parahippocampal regions. A positive association was also observed between total lesion load and bilateral activation of the dorsolateral prefrontal cortices. These results suggest that MS patients must recruit a larger network of brain regions to achieve the same level of performance as the norm.
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P. ARNETT, J. RANDOLPH, & P. FRESKE. Motor Problems Do Not Explain Speeded Attentional Deficits in Depressed MS Patients.
Recent research has demonstrated that depressed individuals with multiple sclerosis (MS) display their greatest cognitive deficits in speeded attentional functioning. Relatedly, MS patients often experience primary problems with motor slowing. It may be that the cognitive deficits observed in depressed MS patients are, in part, a function of motor slowing because tasks measuring speeded attentional functioning require a motor response. The present investigation was designed to test this hypothesis. Fifty clinically definite MS patients were administered the Evaluative subscale of the Chicago Multiscale Depression Inventory (CMDI), the Symbol Copy Test (SCT) from the WAIS–III, a digit cancellation test requiring examinees to cross out all "6's," and a matched digit cancellation task requiring examinees to cross out all "4's" and "7's". Hierarchical regression analysis with the CMDI as the criterion variable revealed that the SCT did not contribute significant variance to CMDI score when entered at step 1. Additionally, after the SCT was entered, the "6" digit cancellation task still contributed significant unique variance (12%, $p < .02$) at step 2, and the "4/7" digit cancellation task contributed additional unique variance (8%, $p < .05$) when entered next at step 3. Our findings suggest that motor output problems cannot account for the speeded attentional deficits associated with depressive symptomatology in MS. It may be that negative self-evaluative thoughts associated with depression, as measured by the CMDI Evaluative subscale, interfere with speeded attentional task performance because they use up some of the limited cognitive capacity available for performance on such tasks.
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A. INSCORE, M. KABAT, R. KANE, P. SHORT, R. OUAOU, P. HAUSER, & M. KLING. Neurocognitive Sequelae of Interferon Alpha Treatment in Patients with Hepatitis C.
Interferon alpha (IFN-α) is a naturally occurring glycoprotein commonly used in the treatment of hepatitis, cancer, and amyotrophic lateral sclerosis. The neuropsychiatric sequelae of IFN-α are well documented. The onset of depressive symptomatology (e.g., psychomotor retardation, social withdrawal, apathy, somnolence) has been the most consistent finding related to IFN-α initiation (Dieperink et al., 2000; Hauser et al., 2000; Mapou et al., 1996). Neurocognitive sequelae of IFN-α treatment are less clear. Few studies have examined this specific issue, and findings have been inconsistent. Impairments in concentration, motor coordination, alertness, verbal memory, psychomotor slowing, and aspects of executive functioning have been reported by some investigators (Dieperink et al., 2000; Meyers et al., 1991). However, Mapou et al. (1996) reported little change in neuropsychological function during IFN-α treatment. Inconsistencies may have related to small sample size, IFN-α dosage, or the impact of depression. The present study seeks to further clarify the neurocognitive sequelae of IFN-α treatment by examining the neuropsychological function of a larger sample of Hepatitis C patients, while controlling for concomitant depression. Participants were 50 Hepatitis C patients undergoing IFN-α treatment at a large university based medical center. Mean age was 45 (SD = 9.89) and education was 13 years (SD = 1.41). A battery of automated and traditional neuropsychological measures known to be sensitive to medication effects was administered to patients during a pretreatment phase and 3 months into IFN-α treatment. Preliminary results revealed a statistically significant reduction in psychomotor processing speed on both automated and traditional measures during the treatment phase of the protocol.
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M.A. NORMAN, M. JACOBSON, & J. COREY-BLOOM. Retrieval and Forgetting Performance in Multiple Sclerosis: CVLT Evidence.
Previous studies have demonstrated impaired memory performance in multiple sclerosis (MS) subjects; however, it is unclear whether or not these differences truly reflect a retrieval deficit. Recently, Norman et al.

(2000) developed new indices for the California Verbal Learning Test using measures of Short and Long Delay Forgetting and a Retrieval Index. Interindividual Short and Long Delay forgetting rates and Retrieval performance were calculated by comparing actual performance to predicted performance in MS and normal control (NC) subjects. In the current study, we applied these normative based equations to Poser (1983) defined MS subjects ($n = 32$) and a group of age and education matched normal controls ($n = 34$). As expected, MS subjects performed significantly worse than NC subjects on Short Delay Free Recall ($p < .001$), Long Delay Free Recall ($p < .001$), and Discriminability ($p < .001$). We then compared the groups' obtained and predicted scores using the newly developed indices of forgetting and retrieval. Differences between MS subjects' obtained and predicted values were significantly greater than NCs on Short Delay ($p = .012$) and Long Delay ($p < .001$) measures. The 2 groups did not differ on the Retrieval Index. These findings suggest that not only do MS subjects have impaired Short and Long Delay recall, but also have a more rapid rate of forgetting. Additionally, these findings do not support a retrieval deficit hypothesis in MS.

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Paper Session 5/9:00–10:45 a.m.

HIV/AIDS

Y. RASSOVSKY, K. MASON, D. THRASHER, S. CASTELLON, M. LAM, D. HARDY, M. STEFANIAK, R. DURVASULA, & C. HINKIN. Psychomotor Slowing as a Mediator of Neurocognitive Deficits in HIV-1 Infection.

It has been well documented in the HIV literature that neurocognitive functioning tends to deteriorate as a function of illness severity. Recently, it has been suggested that a single common factor, psychomotor slowing, may mediate other HIV-associated neurocognitive deficits (Becker & Salthouse, 1999; *JINS*, Vol. 5, 41–47). We tested this hypothesis in 132 HIV-infected individuals, employing a structural equation modeling technique, which allows the simultaneous test of the predictive power of illness severity, as well as the mediating effect of psychomotor slowing, on each cognitive domain. Indexing illness severity with CD4 count and viral load, we found overall support for the hypothesized model in terms of the comparative fit index (CFI = .92) and the root mean-square error of approximation (RMSEA = .07). Psychomotor speed significantly mediated the relationship between illness severity and divided attention/speeded executive functioning, as well as declarative memory. These 2 factors, divided attention/speeded executive functioning and declarative memory had no direct relationship with illness severity. In contrast, untimed executive functioning, although having a significant relationship with psychomotor speed, also had a direct relationship with illness severity. While these findings provide partial support for the hypothesis that psychomotor speed plays an important role in mediating cognitive decline among HIV-infected individuals, it appears that certain cognitive domains (especially those that do not capitalize on information processing speed) decline as illness progresses independently of psychomotor slowing.

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J. O'NEILL, J. RACENSTEIN, E. MARTIN, J. COOK, M. COHEN, P. STEIGMAN, J. BURKE, & K. STALEY. Cognitive Correlates of Adherence with HAART in HIV+ Women.

Although recent literature has begun to examine the effects of neurobehavioral performance in HIV seropositive women, few studies have focused specifically on the role of cognitive functioning in ability to adhere to highly active antiretroviral therapy (HAART) regimens in this population. In the current study, we used a brief cognitive battery with measures of premorbid IQ, verbal fluency, and mental control to examine 115 HIV seropositive women (primarily urban, African American, and low income) enrolled in a larger study of adherence with HAART. Findings were controlled for age, education, disease status (as defined by CD4 count), and depression. We found a significant relationship between a composite score of overall cognitive performance and adherence ($p < .05$), which we defined as taking the correct number and type of medications on randomly selected days. To corroborate the subject's self-report, we compared pharmacy reports of prescribed medications and doses with reported adherence. The data suggest that cognitive measures are useful in predicting HIV treatment adherence in this complicated population. In addition, the overall results showed good levels of medication adherence in this population; this finding is notable given HIV+ women's generally low incomes and multiple comorbid conditions. This is one of the first large studies investigating cognitive predictors in antiretroviral medication adherence by HIV+ women.

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P. KLAAS, P. WOLTERS, S. MARTIN, L. CIVITELLO, & S. ZEICHNER. Verbal Learning and Memory in Children with HIV.

Children with HIV are at risk for deficiencies in cognitive development, expressive language, gross and fine motor coordination, memory, and attention. Although these deficiencies have been characterized in a fairly global manner, verbal learning and memory have not been specifically examined. This research used the CVLT–C and the WISC–III to examine verbal learning and memory in 43 children (*M* age = 11.1 years) with HIV. Test performance was also compared to CT ratings of atrophy and 2 medical markers. Scores on the CVLT–C and WISC–III were compared to the normative samples of the respective tests. Data was further analyzed by dividing the group according to CNS classification. *Results:* In comparison to the normative sample, the scores on the CVLT–C were lower, but still within the average range on all measures. Children with CNS compromise ($N = 11$) performed significantly worse than noncompromised HIV positive children ($N = 32$) on several measures of the CVLT–C, including learning trials, delayed recall and discrimination, but not on recognition. The 2 groups differed significantly on Full Scale IQ, but not in terms of overall atrophy ratings or medical markers. Test scores were not significantly correlated with CT scan ratings or medical markers. *Conclusion:* Compromise of the CNS secondary to HIV infection in children is highly correlated with deficits in recall of verbal material, but not recognition. These findings indicate that memory deficits associated with HIV and CNS compromise are due to deficiencies in retrieval, but not encoding.

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D. J. MOORE, M. CHERNER, E. MASLIAH, R. GONZALEZ, C. CAREY, J. RIPPETH, T. MARCOTTE, R.K. HEATON, I. GRANT, & THE HNRC GROUP. Neuropsychological Ability and Regional Neuropathology in HIV.

This study examined the relationship between *ante mortem* neuropsychological (NP) ability and post-mortem neuropathological changes [i.e., HIV encephalitis (HIVE) and a putative measure of neurodegeneration (ND)]. Subjects were 27 individuals with comprehensive NP testing within 18 months of death (median = 8.5 months). Blind clinical ratings for 7 NP ability domains, as well as an overall global rating, were derived from demographically corrected *T*-scores of individual NP tests. HIVE was measured by immunolabeling against HIV gp41 envelope protein and was measured in several different brain regions. Additionally, tissue sections were immunolabeled with an antibody against calbindin reflecting the number of calbindin-containing neurons in the frontal cortex and basal ganglia, which has been suggested as a measure of ND in HIV disease. A trend was found between a continuous measure of HIVE and global clinical rating ($F(1,25) = 2.7$, $p = .11$, $R^2 = .10$). There were significant associations between the severity of HIVE and NP ratings of learning ($F(1,25) = 8.6$, $p < .01$, $R^2 = .26$), abstraction ($F(1,25) = 8.1$, $p < .01$,

$R^2 = .27$), attention ($F(1,25) = 5.1$, $p < .05$, $R^2 = .17$) and verbal abilities ($F(1,25) = 6.0$, $p < .05$, $R^2 = .20$). No relationship was found between the number of calbindin-containing neurons and NP ability. Despite the preliminary nature of this study, these findings support the hypothesis that HIV-related cognitive impairment is associated with the presence and severity of HIVE. Although NP functioning was not related to the number of calbindin-containing neurons, it is uncertain whether this measure reflects true neurodegeneration in this sample because data regarding the density of calbindin-containing neurons in HIV− individuals is sparse.

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M. RIVERA MINDT, R.K. HEATON, T. MARCOTTE, D. J. MOORE, K. WEINBERG, I. GRANT, & THE HNRC GROUP. Vocational Ability, Employment, and Neuropsychological Impairment in HIV Infection.

Individuals with HIV-associated neuropsychological (NP) impairment have been shown to demonstrate an increased rate of unemployment and reduced performance on standardized work samples. The objective of this study was to examine the relationships between degree and type of NP impairment, work samples assessment, and employment in HIV. *Methods:* 271 HIV+ participants completed comprehensive NP, vocational, and neuromedical evaluations. Based upon the results of the NP and neuromedical evaluations, participants were diagnosed as NP Normal (NPN; $n = 172$), NP Subsyndromically Impaired (NPSI; $n = 66$), or Minor Cognitive Motor Disorder (MCMD; $n = 33$). *Results:* The NPSI and MCMD groups performed significantly worse than the NPN group on all domains of vocational ability (i.e., work samples), and those who failed the work samples assessment were significantly less likely to be employed. Multivariate analyses revealed that verbal functioning, abstraction/executive functioning, processing speed, attention, and motor functioning were all strongly associated with overall vocational ability ($R^2 = .58$). Whereas vocational ability, AIDS status, and NP functioning were singly predictive of employment status, only NP variables were significant when all 3 domains were combined. Among NP ability areas, processing speed, abstraction/executive functioning, and learning were the best predictors of employment. *Conclusions:* These findings suggest that multiple NP domains are strongly related to both vocational ability and real world functioning. Neuromedical, vocational, and NP evaluations can inform the prediction of HIV-related unemployment, but performance on measures of processing speed, abstraction/executive functioning, and learning appear to be the best predictors of HIV-related unemployment.

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D. MOSER, M. BENJAMIN, J. PAULSEN, S. SCHULTZ, S. ARNDT, F. FLEMING, C. BREMS, P. APPELBAUM, & N. ANDREASEN. Decisional Capacity and Informed Consent in Schizophrenia and HIV Research.

The degree to which people with psychiatric illness can provide informed consent to participate in research is a controversial issue. Data on the decisional capacity of such individuals are needed in order to guide the continued improvement of ethical guidelines. The objective of this study was to compare capacity for research informed consent in subjects with schizophrenia and subjects with HIV, and to determine the relationships among neurocognitive dysfunction, psychiatric symptoms, and decisional capacity. Twenty-five men and women with a DSM–IV diagnosis of schizophrenia and 25 individuals with HIV were recruited from the University of Iowa Hospitals and Clinics. The 2 groups were compared on ability to provide informed consent to a hypothetical drug trial, and also on neuropsychological test performance and psychiatric symptom ratings. Results showed that a large majority of subjects in both groups demonstrated capacity to provide research informed consent, although the schizophrenia group obtained significantly lower mean scores than the HIV group on some aspects of the decisional capacity assessment. Neurocognitive functioning and psychiatric symptoms such as apathy and avolition were significantly associated with decisional capacity in the schizophrenia group, whereas psychotic symptoms (hallucinations and delusions) were not. Our findings suggest that most individuals with schizophrenia or HIV are able to provide research informed consent. Furthermore, neurocognitive dysfunction and the types of symptoms found to be associated with impaired decisional capacity are not unique to schizophrenia. Therefore, decisional capacity must be assessed carefully in all research subjects, regardless of the specific diagnosis under study.

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J. RIPPETH, R.K. HEATON, C. CAREY, T. MARCOTTE, D. J. MOORE, R. GONZALEZ, & I. GRANT. Effects of HIV Infection and Methamphetamine on Specific Cognitive Domains.

The neuropsychological (NP) effects of HIV infection are well-documented; less is known about NP effects of methamphetamine (METH) and the combination of HIV+ serostatus and METH. Four groups were examined: (1) HIV+/METH+, $n = 43$; (2) HIV−/METH+, $n = 47$; (3) HIV+/METH−, $n = 50$; (4) HIV−/METH−, $n = 60$. METH+ groups met DSM–IV criteria for METH dependence and were at least 10 days abstinent at testing. Groups were comparable for age, education, and ethnicity; however METH+ and HIV+/METH− groups had more males than the HIV−/METH− group ($p < .01$). A comprehensive NP battery assessed Verbal Fluency, Attention/Working Memory, Abstraction, Processing Speed, Learning, Memory, and Motor Skills. Demographically corrected *T*-scores were used to derive global and cognitive domain summary scores. Cut-off scores for NP impairment were determined by a separate HIV− control group ($N = 30$) demographically comparable, but lacking NP risk factors evident in the study groups (e.g., history of alcohol abuse). Cut-off scores were validated against blind clinical ratings of a larger HIV+/HIV− group. HIV+/METH+, HIV−/METH+, HIV+/METH− groups had higher rates of Global NP impairment than the HIV−/METH− group [$\chi^2(3, N = 200) = 13.0$; $p < .01$]. Similar findings were evident in the Attention/Working Memory [$\chi^2(3, N = 200) = 8.1$; $p < .05$] and Motor Skills [$\chi^2(3, N = 200) = 10.5$; $p < .05$] domains. In the Learning Domain, both METH+ groups had higher rates of NP impairment than the HIV−/METH−group; the HIV+/METH+ group had a higher rate of NP impairment than the HIV+/METH− group [χ^2 $(3, N = 200) = 11.2$; $p < .05$]. Results indicate HIV, METH, and the combination of HIV and METH are all associated with NP impairment, both globally, and in cognitive domains associated with frontal-subcortical systems.

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Symposium 3/9:00–10:45 a.m.

THE HIPPOCAMPI, FRONTAL LOBES, AND MEMORY

Organizers and Co-Chairs: M.D. Kopelman and R.G. Morris

M. KOPELMAN & R. MORRIS. The Hippocampi, Frontal Lobes, and Memory.

This symposium will explore the role of the medial temporal lobes, especially the hippocampi, and the frontal lobes in relation to memory. In the first talk, Robin Morris will discuss the effect of hippocampal lesions on encoding and retrieval of spatial memory in egocentric and allocentric conditions. An fMRI study indicated that the hippocampi are activated in both types of spatial memory. In the second talk, Morris Moscovitch will report findings in patients with medial temporal lobe damage, as well as neuroimaging studies of normal people, examining retention and retrieval of remote and recent autobiographical and spatial memory, and contrast-

ing the findings with those in tests of semantic memory. Brian Levine will report findings from a new test of autobiographical memory, circumventing some of the problems of older tests, and will report findings from an fMRI study indicating frontal polar and posterior parahippocampal activations in retrieving autobiographical memories. Michael Kopelman will report findings from a quantitative structural MRI study of 40 amnesic patients, examining correlations with measures of both anterograde and retrograde memory. Significant correlations will be reported between hippocampal volume and conventional and spatial anterograde memory tasks, but correlations with retrograde tests suggest the involvement of widespread neural networks. Taken together, these studies will shed further light on the role of the medial temporal and frontal lobes in memory as well as indicating unresolved issues.

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R.G. MORRIS & D.M. PARSLOW. The Neural Correlates of Egocentric and Allocentric Spatial Memory.

This paper reviews studies of the effects of focal hippocampal formation lesions on egocentric *versus* allocentric spatial memory, examining the evidence that the hippocampus is specifically involved in spatial mapping. It also describes a study in which a virtual reality human analogue of the Morris Water Maze was developed to investigate the neural correlates of spatial memory using functional magnetic resonance imaging (fMRI), and also to investigate spatial memory in patients who have undergone unilateral temporal lobectomies (TL). A circular arena is used as the environment for the subject, moving about using a joystick. The aim is to move to a distant pole (encoding). The pole is then hidden and the subject has to move to the same location (retrieval). In an egocentric condition, the starting point for the retrieval phase is the same as that for encoding, but the wall of the arena rotates between encoding and retrieval to avoid the subject using them as orientation cues. In an allocentric condition, the retrieval starting point is a different location, but the wall stays in the same position. A visual control condition was used with random patterns. Activation was obtained in a network of neural structures relating to spatial memory functioning, with bilateral hippocampal activation associated with allocentric encoding specifically. Both left and right TL patients showed impairments in both the egocentric and allocentric conditions. The study implicates the hippocampal formation in both egocentric and allocentric spatial memory processing, but suggests greater activation associated with allocentric processing.

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M. MOSCOVITCH. The Hippocampal Complex and Consolidation of Episodic and Semantic Memory: Evidence from Clinical and Neuroimaging Studies.

The hippocampus and related structures in the medial temporal lobe and diencephalon have long been thought to form a temporary memory system that was needed only until memory traces were consolidated elsewhere in the brain. This view is challenged by recent studies of patients with memory disorders consequent to medial temporal damage, and neuroimaging studies of normal people. These studies indicate that the hippocampus and related structures are crucial for retention and retrieval of detailed autobiographical and spatial memories for as long as they exist. Semantic memory, on the other hand, benefits from an intact medial temporal system in the early stages of memory formation, but then can survive without it. We will present evidence from new studies to support this view of differential contribution of the medial temporal lobes and posterior neocortex to consolidation, retention, and retrieval of remote autobiographical and semantic memory.

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B. LEVINE. The Functional Neuroanatomy of Everyday Autobiographical Memory.

In a typical study of autobiographical memory, participants are asked to retrieve episodes from their personal past in response to a cue such as a word or a time period. Interpretation of the results of these studies is complicated by lack of control over the encoding episode and reactivation of the memory. We have developed a novel paradigm for the prospective acquisition of autobiographical stimuli that largely circumvents these problems. Participants ($N = 5$) documented everyday episodes from their life over a 6 month period using a microcassette recorder. They were instructed not to listen to the excerpt following recording. Approximately 10% of the excerpts were selected at random for exposure during scanning, much the same way words would be selected from a list in a traditional encoding and retrieval study. The excerpts were edited and presented auditorily, evoking a strong feeling of re-experiencing. In comparison with various other control conditions, the personal episodic material was associated with frontal polar and posterior parahippocampal activations, corresponding to both lesion research and prior functional imaging studies of autobiographical memory. Data are also presented concerning the effects of time delay (age of memory), degree of re-experiencing, and emotional change at the time of encoding.

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M. KOPELMAN, A. COLCHESTER, & D. LASSERSON. The Hippocampus and Medial Temporal Lobes in Anterograde and Retrograde Amnesia Quantified MRI Measures.

Quantified MRI can be a useful technique with which to examine brain-cognitive relations, provided that techniques are explicitly described. Loss of volume in key brain structures (e.g., hippocampus, thalamus) is detectable, and this loss of volume was found to correlate significantly with impaired performance on measures of anterograde memory function in 40 amnesic patients. There was a correlation between hippocampal volume and spatial context memory, but no specific relationship with measures of recall, as opposed to recognition, memory. For retrograde amnesia, the findings supported the view that widespread neural networks are involved in the storage and retrieval of remote memories, and regression analyses based on the MRI measures accounted for approximately 60% of the variance in autobiographical memory scores. However, the findings did not support the view in patients with medial temporal damage that the severity of retrograde amnesia would be proportionate to the extent of medial temporal lobe damage.

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Symposium 4/9:00–10:45 a.m.

PEDIATRIC NEUROPSYCHOLOGICAL DISORDERS: CONTENT, NEURODEVELOPMENTAL DYNAMICS, THEORY

Organizer and Chair: B.P. Rourke

B.P. ROURKE. Pediatric Neuropsychological Disorders: Content, Neurodevelopmental Dynamics, and Theory.

Research activity in child-clinical/pediatric neuropsychology has been growing by leaps and bounds over the past 10 years. In this symposium, we attempt to present examples of recent activity in this area, with a specific focus on the diversity of research approaches, outcomes, and theories that currently hold sway in the field of neurodevelopmental disorders. Each participant has been asked to present the content (i.e., neuropsychological assets and deficits), neurodevelopmental dynamics (i.e.,

cause-effect relationships over the developmental course), and theoretical considerations (i.e., the brain-behavior relationships involved) for the neurodevelopmental disorders in question. The presentations include a fairly common disorder (traumatic brain injury), a relatively rare genetic disorder (Kabuki syndrome), a fairly common congenital disorder (congenital hypothyroidism), a prevalent disorder of multiple etiologies (extremely low birthweight), and a set of neurodevelopmental disorders about which there is considerable theoretical debate ("autistic spectrum" disorders). Each of the participants has been intimately involved with research in the areas in which they are presenting, and the Discussant was chosen because of his expertise in many areas of the neurodevelopmental disorders of infancy and childhood. The entire effort is structured to insure that the presentations will allow for comparisons of theoretical and applied interest between and among the disorders under discussion.

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K.O. YEATES. Traumatic Brain Injury.

Traumatic brain injury (TBI) in children is a major public health problem. It is a leading cause of death among youth and results in substantial neurobehavioral morbidity for survivors. Pediatric TBI can result in a wide range of neurobehavioral outcomes, including deficits in intellectual functioning, language and nonverbal skills, attention, memory, and executive functions. These deficits often give rise to academic difficulties in school. Social and behavioral problems also occur frequently after TBI, although cognitive and behavioral outcomes are often only weakly related and follow different time courses following injury. Recovery from traumatic brain injury is a complex process that depends on the age at which injury occurs, the time that has elapsed since injury, and the age at which children are assessed. Recent research suggests models of recovery also must be biopsychosocial in nature, and take into account not only injury characteristics, but also environmental factors that moderate outcomes. Relevant injury characteristics include various indices of severity, such as the Glasgow Coma Scale score and duration of impaired consciousness. Environmental factors that affect outcomes include preinjury family functioning, as well as parental psychological distress and perceived burden after an injury. Future research regarding pediatric TBI must attend to issues of sample selection, recruitment, and attrition; the assessment of injury characteristics and noninjury related factors as predictors of outcomes; outcome measurement; and modeling of recovery as a continuous process.

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H. VAN DER VLUGT, K. BERNDSEN-PEETERS, L. CURFS, & C. SCHRANDER-STUMPEL. Assessment Profile in the Kabuki Syndrome.

In 1981 Niikawa et al. and Kuroki et al. reported the first cases of the Kabuki (Niikawa-Kuroki) syndrome. Ten unrelated Japanese children with a characteristic array of multiple congenital anomalies and mental retardation were reported. The phenotypic syndrome is characterized by a distinct face, mild to moderate mental retardation, postnatal growth retardation, dermatoglyphic (persistent fetal fingertip pads) and skeletal abnormalities. In the face, the long palpebral fissures with eversion of the lateral lower eyelid and the depressed nasal tip (the cleft palate, dysmorphic ears, and preauricular pits) give the child a somewhat "oriental" appearance. In Japan the syndrome appears to have an incidence of about 1 in 32,000 newborns. Recently a growing number of patients has been recognized. In two thirds of the non-Japanese patients serious neurological problems were present, most notably hypotonia and feeding problems. As of today behavioral characteristics and neuropsychological assessment profiles are not well known. Data of 11 persons with Kabuki syndrome (only 12 are registered in the Netherlands) were evaluated, 8 females and 3 males. Ages ranged from 4;4 to 33 years, 9 of them between 7 and 10 years of age. The neuropsychological assessment consisted of tests of intelligence, sensory and perceptual abilities, visual, motor and psychomotor skills, attention and memory, concept formation and problem solving, language skills, academic achievements, and measures of fine and gross motor coordination. Although many aspects of the cognitive abilities remain to be explored, certain similarities with the NLD syndrome will be discussed.

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J. ROVET. Congenital Hypothyroidism (CH): A Model for Early Brain Development.

Although early diagnosis and treatment of congenital hypothyroidism (CH) following newborn screening prevents the mental retardation previously associated with cretinism, these children are still at risk for subtle selective neurocognitive deficits, the nature of which reflect insufficient levels of thyroid hormone (TH) during the postpartum period, and in some children, the third trimester. An extensive animal literature shows that in the period when offspring with CH are TH-deficient, adequate levels of TH are required for the proper development of the caudate, hippocampus, and posterior cortex and for neurotransmission. To determine whether these structures are similarly affected in humans, we have been following several cohorts of children with CH whose cognitive abilities were extensively studied with both psychometric neuropsychological instruments and laboratory-based tests of attention, memory, and visual processing, as well as electrophysiological procedures. Results have revealed a pattern of deficit suggestive of a mild nonverbal learning disability, the inattentive ADHD subtype, an episodic memory deficit, and problems in verbal and visual associative memory. Correlations between time-locked disease factors and outcome suggest that structures supporting visual processing appear to be vulnerable to prenatal TH deficiency, whereas structures important for memory are vulnerable to postnatal TH deficiency. Attention reflects TH levels at time of testing and suggests an ideal range for optimum attention. Until confirmation with neuroimaging, behavioral evidence suggests compromised development of parietal lobes, hippocampus, and caudate following late gestational and early postnatal TH loss.

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H.G. TAYLOR, N. KLEIN, & M. HACK. Neurodevelopmental Characteristics of Children With Very Low Birth Weight.

Advances in medical technology have resulted in increased survival of very low birth weight (VLBW, $<$ 1500 g) children, especially those born at the lower limits of viability. VLBW children exhibit a variety of sequelae, including global and specific cognitive deficits, behavior problems, and educational difficulties. However, researchers have made little progress in isolating primary from secondary impairments, understanding how variations in neuropathology and environmental factors lead to individual differences in outcomes, or identifying developmental changes in sequelae. The purpose of this paper is to highlight these research needs by reviewing relevant literature and by proposing a model that considers variations in underlying neuropathology and in environmental supports as predictors of cognitive, behavior, and achievement outcomes. Results from the authors' ongoing follow-up of VLBW children will be used to illustrate school-age sequelae, to test the proposed model, and to examine age-related changes in sequelae. The original sample, recruited at a mean age of 7 years, included matched groups of 68 children with $<$ 750 g birth weight, 65 with 750–1499 g birth weight, and 61 term-born children. The children were reassessed at multiple points over a 7-year period. Study findings reinforce the benefits of broadened conceptions of brain-behavior relationships that include measurement of specific cognitive deficits and specification of neuropathology and environmental influences. The results also underscore the need to map developmental change and to propose neurodevelopmental theories that can account for both change and stability in outcomes over time.

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K.D. TSATSANIS. Pervasive Developmental Disorders.
The pervasive developmental disorders (PDDs) encompass several clinical entities, including autistic disorder, Asperger syndrome, PDD–NOS, Rett syndrome, and childhood disintegrative disorder. They represent a class of disorders that have at their core a qualitative impairment in reciprocal social interaction as well as a disturbance in the development of verbal skills and patterns of play/interests. The conditions are often represented in the literature as lying along a continuum (e.g., the term "autism spectrum disorders") that varies in terms of level of severity. Attempts to clarify the boundaries have been a clinical endeavor but have wider ranging implications in terms of being able to uncover neurobiological and genetic etiologies. In this regard, an approach that considers content, dynamics, and models of neurofunctioning becomes especially meaningful. For example, whether high functioning autism (HFA) and Asperger syndrome (AS) are distinct clinical entities is an area of marked debate. One way to examine this issue is through a process of external validation. The value of a neuropsychological profile—Nonverbal Learning Disabilities (NLD)—is proposed because it might offer an external validator of AS relative to HFA. The content of NLD is very similar to AS and a consideration of its neurodevelopmental dynamics provides some very useful parameters for further phenotypic characterization.
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Birch Lecture/11:00 a.m.–12:00 p.m.

WHAT HAPPENED TO VASCULAR DEMENTIA?

Vladimir Hachinski

Thursday Afternoon, February 14, 2002

Poster Session 3/1:00–6:45 p.m.

ALZHEIMER'S DISEASE

J. HIGGINS, L. GRANDE, R. McGLINCHEY-BERROTH, & W. MILBERG. Preattentive But Not Attentive Processing in Alzheimer's Disease.
Attentional dysfunction is one of the earliest deficits observed in Alzheimer's disease (AD). Studies support the hypothesis that selective attention is impaired and that some attentional failures in the AD patient can be explained by impaired inhibitory control of distracting information. The present study investigated this possibility in the context of a visual search paradigm designed to assess preattentive and attentive abilities in patients with AD. Subjects were asked to detect the presence or absence of a single target among various numbers of distractors (1, 6, 12). In the preattentive serial search the target was unique and appeared to pop out of the display regardless of the number of distractors present. In the attentive serial search, the target lacked a feature that was present in the distractors, thereby being more difficult to locate and requiring an attentive serial search. AD patients and normal controls (NC) displayed a similar pattern of reaction times in the pop out condition with reaction times remaining relatively constant across increasing numbers of distractors (regression slopes-AD target present = 8 ms/item, target absent = 0; NC target present = 6, target absent = .7). In the serial condition both groups displayed increasing reaction time across increasing numbers of distractors in both the target present/absent trials. However, AD reaction times increased at a much greater rate than did those of normal controls (regression slopes-AD target present = 67 ms/item, target absent = 166; NC target present = 37, target absent = 115). These results suggest preattentive processing but not focused serial attention may be intact in AD patients.
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K. HANNESDOTTIR & R. MORRIS. A Study of Insight in Alzheimer's Disease.
"Lack of insight" is a phenomenon well recognized in Alzheimer's disease (AD). Although documented in early clinical observations and often considered a hallmark for the illness, research remains scarce and the condition poorly understood. There are both theoretical and clinical importances of studying insight. Theoretically, it makes us wonder about the mechanism that normally allows people to be aware of their own cognitive functioning. Clinically speaking, impaired insight may form an obstacle for rehabilitation, whereas patients may refuse to participate in remedial intervention. It can also result in poor interaction between patient and caregiver, thus perhaps increasing caregiver burden. Patients may also undertake activities too difficult for them to perform, such as driving a car or returning to work. The purpose of this study is to further understanding and insight by looking at neuropsychological patterns, behavior, and SPECT. It is hypothesized that the degree of insight correlates with executive functioning and caregiver burden. The study is conducted at the only specialized memory clinic in Iceland. One hundred Icelandic AD patients are compared with 70 normal controls. The age of subjects ranges from 65–85 years. The research is conducted from a profile approach with three quantitative measurements used to investigate insight. Insight is also investigated in relation to neuropsychological functioning and brain functioning using SPECT. Initial findings suggest an association between insight and executive functioning. Moreover, patients with poor insight are more likely to drive a car and consider themselves competent drivers.
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M. CASTAÑEDA, F. OSTROSKY-SOLIS, J. GARCIA-REYNA, J. GARCIA-MARIN, & L. GUTIERREZ. Mild Cognitive Impairment and Verbal Memory Using a Single Photon Emission Computerized Tomography SPECT Study.
Ten patients with mild cognitive impairment (MCI) and 10 matched normal controls were examined with SPECT, using split-dose $_{99m}$Tc-exametazime. The baseline condition involved repetition of the word "yes" or "no." The activation condition involved recognition (indicated by a "yes" or "no") of words from a previously learned list presented along with distractor words. Uptake of $_{99m}$Tc-exametazime was estimated at baseline and during the word recognition task for predetermined regions of interest drawn from a standard neuroanatomical atlas. During the recognition task, controls but not patients showed activation effects. These were most prominent in right putamen and right posterior cingulate cortex. Among patients, changes were observed in subcortical regions. These findings may be considered as early predictors of dementia.
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H.C. KOEHN, P.J. MASSMAN, & N. COOKE. Neuropsychological Correlates of Rey Complex Figure Test Organizational Strategies in Alzheimer's Disease Patients.
Visuoconstructive deficits are common in probable Alzheimer's disease (AD) patients. One widely-used clinical measure of visuoconstructive ability is the Rey-Osterrieth Complex Figure Test (Rey–CFT). A number of

scoring systems have recently been designed to tap a patient's ability to organize their construction of the figure. One recent investigation indicated a relationship between executive functioning and organizational scores (Somerville, 2000). The current study evaluated which neuropsychological variables are related to Rey–CFT organizational scores. One hundred and seventy two probable AD patients' Bylsma (Bylsma et al., 1998) and Shorr (Shorr et al., 1994) organizational scores were correlated with measures of dementia severity (MMSE, ADAS), visuoperceptive/visuospatial abilities (WAIS–R Perceptual Organization), executive functioning (FAS letter fluency, go/no-go tasks), attention/concentration (WAIS–R Freedom from Distractibility, Verbal Series Attention Test), and verbal functioning (WAIS–R Verbal Comprehension, Boston Naming Test, BNT). There were high correlations between Rey–CFT measures and modest correlations between Rey–CFT scores and dementia severity. After controlling for dementia severity (MMSE partialed), significant correlations were found between Rey–CFT organizational scores and measures of visuoperceptual/visuospatial abilities and attention/concentration. Bylsma organizational scores were dichotomized into high and low groups and ANCOVA (with MMSE as the covariate) revealed significant differences for visuoperceptive/visuospatial, attention/concentration, and unexpectedly for BNT. Traditional Rey–CFT copy scores were subtracted from Bylsma organizational standard scores to yield a discrepancy score. There were no significant correlations between these discrepancy scores and the neuropsychological test scores. Overall, our results indicate that in AD patients, Rey–CFT organizational performance is most strongly related to general visuospatial/visuoperceptual abilities and attention/concentration.

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L. DUKE, B. SELTZER, J. SELTZER, & J. VASTERLING. Dissociating Cognitive Components of Deficit Awareness in Alzheimer's Disease.

Underawareness of deficit in Alzheimer's disease (AD) was examined using 2 paradigms: performance prediction–postdiction (PPP) and questionnaire discrepancy (QD). Twenty-four individuals with diagnoses of probable Alzheimer's disease (AD) and their healthy, age- and education-comparable spouses participated. During a verbal memory test, participants made predictions and postdictions regarding their own memory, as well as the memory of their spouses, and of "Mrs. Smith," a fictional, memory-disordered patient previously observed on videotape. QD data revealed that AD patients underestimated their difficulties in performing self-care tasks, as compared to caregivers' reports. Participants' predictions and postdictions for the memory performance of each Ratee (AD, Caregiver, "Mrs. Smith") were compared to participants' actual memory scores using log-transformed ratio scores. (For "Mrs. Smith," normative data were substituted for memory scores.) A repeated measures, multivariate general linear model analysis was conducted with Group (AD, Caregivers) as the between-subjects factor and Ratee, Trial, and Time (Prediction, Postdiction) as within-subjects factors. A significant Ratee $\times$ Time $\times$ Group interaction emerged, $F(2,44) = 4.51$, $p = .017$. AD patients overpredicted their own performance, but were able to decrease the extent of their overestimation when making postdictions. Both groups were relatively accurate at estimating caregivers' performance, but overestimated for the fictional, memory-disordered patient. Results support assertions that awareness of deficit in AD is a complex ability, involving dissociable cognitive processes. Individuals in early stages of AD may display intact immediate awareness of their memory dysfunction, but fail to incorporate incidents of memory failure into their generalized self-belief systems.

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H.C. KOEHN, P. J. MASSMAN, & N. COOKE. Hemispatial Inattention on the Rey-CFT in Alzheimer's Disease Patients.

Hemispatial inattention has rarely been reported in the existing Alzheimer's disease (AD) literature. However, recently 2 group studies (Cherrier et al., 1999; Ishiai et al., 1996) and at least 1 case study (Bartolomeo et al., 1998) have reported its occurrence in AD patients (Bartolomeo et al., 1998; Cherrier et al., 1999; Ishiai et al., 1996). In an effort to further investigate this possibility, 172 probable AD patients' copies of the Rey-Osterrieth Complex Figure were analyzed for evidence of hemispatial neglect. Copy productions were divided into left and right halves using the major vertical bisector as the dividing point. Since 4 distinct elements are located to the left of the bisector (box with diagonals, left cross, bottom box, 4 horizontal lines) and 6 elements are located to the right (right triangle, diamond, circle with dots, top triangle, 5 crosshatch lines, bottom cross) a multiplication correction of 1.5 was applied to all left side data. This analysis revealed that 87 patients (51%) were given credit for fewer items upon the left side of the figure than the right. This nearly equal distribution occurred despite the fact that items on the right tend to be simpler to draw and therefore more likely to receive credit. Additionally, in order to examine the possible relationship between Rey hemifield differences and verbal *versus* visuospatial cognitive asymmetry, right *versus* left differences in Bylsma organizational Rey scores were correlated with WAIS–R Verbal Comprehension minus WAIS–R Perceptual Organization difference scores. This correlation, while technically significant ($r = .17$, $p < .05$) was modest.

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R. WESTMACOTT, M. MOSCOVITCH, S. BLACK, & M. FREEDMAN. Temporally-Graded Retrograde Semantic Memory Loss in Alzheimer's Dementia: A One-Year Follow-Up Study.

Semantic knowledge of famous names and words that entered popular North American culture at different times in the 20th century was examined in a group of patients with mild-to-moderate Alzheimer's dementia (AD). Some patients were re-tested 1 year later. All patients showed evidence of temporally-graded memory loss, with names and words from the remote past being relatively better preserved than those from more recent times. A slight increase in performance was found for the most recent items, but only when correct guesses were considered and not when performance scores were based upon confident, explicit recognition. There was considerable between-patient variability with respect to severity of semantic impairment. Most patients exhibited losses extending back 30–40 years; however, 2 mildly impaired (MMSE $>$ 28) patients showed deficits confined to the last 10–15 years. At the 1-year follow-up, patients not only exhibited a more severe deficit overall, but the temporally-graded period of loss extended further back in time suggesting that this deficit is not solely due to faulty encoding. The extensive period of graded semantic loss exhibited by most patients contrasts with the temporally limited retrograde semantic loss typical of medial temporal amnesia. We propose that short periods of temporally-graded semantic memory loss can be explained by damage to medial temporal structures, but that extensive periods of graded loss occur only with additional damage to neocortical tissue. This pattern contrasts with that of episodic memory loss which often is ungraded and extends for the person's entire lifetime, even in early stages of the disease.

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C. DAGENAIS, I. ROULEAU, & G. DESMARAIS. Residual Learning Abilities in Brain-Injured Children: Comparison of Two Learning Techniques.

Although, in adults, semantic memory is generally resistant to brain injury, profound loss of academic knowledge is often observed in brain-injured children. In order to facilitate the learning of new academic material in memory-impaired children, two methods—vanishing cues and anticipation-repetition learning (known to rely mostly on implicit and explicit memory processes, respectively)—were applied to the learning of new vocabulary items. All subjects (6 brain-injured and 6 controls) were

administered the 2 methods with counterbalanced lists. No differences were observed between the 2 methods in either group in terms of facilitating the learning and conservation over time of new vocabulary words. In our study, the fact that the "vanishing cue" method was no more effective than a more explicit learning method may be due to degree of severity of amnesia; since our patients were not severely amnesic, they tended to treat the "vanishing cue" more as an explicit cued recall than as an implicit recall. It is possible that in severely amnesic patients the "vanishing cue" method would have some advantages over other methods that rely more on explicit memory processes. Because the "vanishing cue" method involves so many diverse processes (depending on subjects' characteristics and the demands of the task), its value as a research tool to disentangle the roles of implicit and explicit memory in the recall of newly acquired information is limited. However, as a clinical tool, because of the high motivational level it elicits in subjects, especially children, the "vanishing cue" method remains highly appropriate in rehabilitation settings.
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D. CAHN-WEINER, J. GRACE, B. OTT, & H. FERNANDEZ. Cognitive and Behavioral Features of Alzheimer's and Parkinson's Disease Patients.

Neuropsychological studies of Alzheimer's disease (AD) and Parkinson's disease (PD) patients have generated debate over the distinction between "cortical" and "subcortical" dementias, with some studies showing significant differences and others showing little difference in the cognitive profiles of these groups. In order to address this issue, we examined both cognitive and behavioral profiles of AD and cognitively-impaired PD patients on 2 frequently used assessment instruments. The goal was to determine the individual measures that best discriminate the 2 patient groups. Eighteen AD patients and 18 PD patients, matched on age and education, were administered the Mattis Dementia Rating Scale (DRS) and Frontal Systems Behavioral Inventory (FrSBe; formally FLOPS). The 2 groups did not differ on overall DRS score or total FrSBe Score. However, examination of subscale performances revealed that the AD patients performed significantly worse than the PD patients on the Memory subscale of the DRS ($p < .001$), and PD patients had more elevated scores than the AD patients on the Apathy subscale of the FrSBe ($p < .05$). When these 2 variables were entered into a discriminant function analysis, an overall classification accuracy of 86% was demonstrated, with 89% of the AD group correctly classified and 83% of the PD group correctly classified. These findings suggest that while global cognitive dysfunction and behavioral disturbance may appear similar in AD and cognitively impaired PD patients, examination of specific variables sensitive to the underlying neuropathology of each disease is effective in discriminating between these 2 neurodegenerative disorders.
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D. SAUMIER, H. CHERTKOW, M. ARGUIN, & J. RENFREW. Categorical Perception Deficits in Alzheimer's Disease: An Effect of Uncertainty in Category Boundaries.

Object recognition impairments in Alzheimer's disease (AD) may arise because the boundaries between object categories represented in their disrupted memory system are uncertain or fuzzy. Saumier, Arguin, and Chertkow (2001) tested this hypothesis by requiring a group of mild to moderate AD patients to categorize a series of 8 computer-generated ellipses that varied along a continuum of width on the basis of 2 memorized shape prototypes corresponding to the extremes of the shape continuum. All participants showed a discontinuity in the probability of categorizing the shapes, suggesting that the objects were classified into distinct categories. However, the magnitude of this categorical effect was significantly less pronounced in the AD patients than in the control group. The present study examined whether the categorical perception deficits in AD patients are the result of difficulties in accessing long-term shape representations in memory. To this aim, a group of 16 AD patients performed the categorical perception task while viewing the shape prototypes. The results indicate that AD subjects consistently show categorical perception impairments under this condition. This provides evidence that object recognition deficits in AD patients do not arise from difficulties in access object representations from memory *per se*, but rather from problems in establishing perceptual boundaries that would otherwise serve to support decisions as to whether an object is a member of a category or not.
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F. UNVERZAGT, B. MUSICK, K. LANE, S. GAO, S. HUI, K. HALL, & H. HENDRIE. Cognitive Correlates of Functional Status in Elderly African Americans.

Objective: To determine cognitive correlates of informant-rated functional status in community-dwelling, elderly African Americans. *Methods:* In a 2-phase study of aging and dementia, 2,212 community-dwelling, African Americans in Indianapolis, IN aged 65 and older received in-home dementia screens. A subset ($n = 351$), stratified on age and cognitive status, received full clinical assessment including CERAD cognitive battery, semi-structured Informant Interview, physical examination, and clinical diagnosis. The Blessed Dementia Scale (BDS), an 11-item, informant-based rating of activities of daily living (e.g., manage finances, household tasks, find way in community, and feed, dress, and bathe self), was included in the Informant Interview. Scores range from 0 to 17 with higher scores indicating more dysfunction. In a multiple regression on BDS scores, age and education were entered as a first step followed by stepwise entry of CERAD scores. *Results:* The clinically assessed subjects averaged 77.5 ± 7.4 years of age, 8.5 ± 3.4 years of education, and 60% female. One hundred eighty-one subjects were diagnosed as normal, 105 cognitively impaired but not demented, and 65 demented. BDS scores ranged from 0 to 13. The first step of the regression indicated a weak affect for age and education on BDS scores ($p = .172$; 4.3% of variance). After controlling for age and education, only Word List Learning Sum Recall from the CERAD battery was significantly related to BDS ($p < .001$; 20.2% of variance). *Conclusions:* New learning is more strongly related to functional status in elderly, community-dwelling African Americans than skill in confrontation naming, verbal fluency, and graphomotor construction.
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R. JONES, K. MANZEL, S. ANDERSON, & M. RIZZO. Neuropsychological Profiles in Visual Variant Alzheimer's Disease.

A visual variant of Alzheimer's disease (VVAD) initially involves progressive deterioration of higher visual functions, but visual acuity is relatively preserved (Levine et al., 1993; Kiyosawa et al., 1989). Pathological and metabolic changes in VVAD affect visual association cortices, particularly in an occipitoparietal location (Levine et al., 1993; Hof et al., 1989; 1990). However, relatively few cases have been described, and with few exceptions (e.g., Furey-Kurkjian et al., 1996), detailed neuropsychological profiles of such patients have generally not been reported. In this study we describe the neuropsychological profiles of 15 subjects with VVAD, and contrast this group with a sample of 11 age- and education-matched subjects meeting standard criteria for Alzheimer's disease (AD). VVAD subjects showed marked impairments in visuospatial abilities compared to AD subjects, whereas AD subjects showed defects in verbal retrieval compared to VVAD subjects. The VVAD group showed specific difficulties on tests of spatial judgment (Judgment of Line Orientation) and visuoconstruction (Complex Figure Copy), with lesser defects of visual perceptive skills (Facial Discrimination Test). Perceptual elements of Balint's syndrome (visual disorientation, simultanagnosia) were evident in several VVAD cases. Although visual impairments have been described in early

AD (Rizzo et al., 2000a; b), the evidence from this and other studies suggests prominent disruption of dorsal visual pathways in VVAD. Further, this study demonstrates that standard neuropsychological tests have considerable utility in defining the profile of VVAD.
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J.H. CERHAN, R.J. IVNIK, G.E. SMITH, & M.M. MACHULDA. Diagnostic Utility of Common Neuropsychological Measures in Differentiating Alzheimer's Disease From Other Dementias.
Research has established neuropsychological profiles that accurately differentiate Alzheimer's patients from normals. This has been accomplished through the identification of cognitive domains (e.g., memory and language) and specific tests (e.g., AVLT delayed recall, Category Fluency) that have shown good diagnostic accuracy. Clinically, though, there is a need to extend and refine our diagnostic capabilities in order to use neuropsychological results to differentiate Alzheimer's from other *types* of dementia. In this study, we explored the diagnostic utility of common neuropsychological measures in differentiating 212 Alzheimer's patients from 66 patients diagnosed with non-Alzheimer's dementia. Several memory and language measures showed highly significant mean differences across the groups ($p = .0001$), with the most significant differences in retention and naming. The groups did not differ on measures in other domains (e.g., visuospatial, attention/concentration, sequencing), nor was there a significant difference on a verbal fluency measure (COWAT). Likelihood ratios showed modest diagnostic utility for selected retention measures (e.g., AVLT delayed recall score below 2, LR = 1.54) and the Boston Naming Test (raw score less than 41, LR = 2.11). It appears that commonly used neuropsychological measures individually have only modest utility in differentiating Alzheimer's disease from a mixed group of other dementias. Further analysis evaluating the diagnostic utility of combinations of measures *via* regression equations, and including other language measures (e.g., Category Fluency) to improve diagnostic power will be presented. Future research should attempt to distinguish Alzheimer's from other homogeneous dementia groups (e.g., Lewy Body Disease).
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M. MURRAY, S. OREY, & L. PAINTER. Indices of Executive Dysfunction From the CERAD Neuropsychological Screening Battery.
The CERAD neuropsychological battery is widely used in dementia screening evaluations and has demonstrated utility for that purpose. The CERAD provides indices for several cognitive domains impaired in dementing illnesses: memory, language, praxis, and global cognitive functioning. The CERAD provides no subtest intended to assess executive functioning although executive dysfunction (ED) is frequently relevant to dementia assessments. While clinicians interpret verbal fluency subtest scores as reflecting contributions from executive functions, the task is sensitive to impairment from multiple domains. Repetition errors during the verbal fluency task and intrusion errors during free recall trials offer a potentially useful index of the presence and severity of ED. This study examined intrusion and repetition errors on CERAD batteries administered to geropsychiatry inpatients (age ≥ 60; $n = 187$). Three diagnostic groups were expected to exhibit ED: Alzheimer's disease ($n = 40$; most ED), chronic schizophrenics ($n = 78$; moderate ED), mood disorders ($n = 69$; least ED). Intrusion and repetition errors were most prevalent in the AD group (92.5%) and least in the mood disorders group (65.2%). Interestingly, intrusion and repetition errors were not significantly correlated. A significant group effect was observed for severity of ED (intrusion errors, $p < .001$; repetition errors, $p < .0003$). When global cognitive impairment (MMSE) was covaried, a significant group effect remained only for repetition errors ($p < .005$). These findings support the utility of the CERAD to detect aspects of ED and suggest that repetition errors may be a less confounded indicator of ED than intrusion errors.
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P.A. BOYLE, P.F. MALLOY, S. SALLOWAY, D.A. CAHN-WEINER, R. COHEN, & J.L. CUMMINGS. Predictors of Functional Impairment in Alzheimer's Disease.
Alzheimer's disease (AD) is associated with declines in cognitive behavioral functioning and is a leading cause of disability among the elderly. Although it is widely recognized that cognitive and behavioral disturbances contribute to functional impairment in AD, few studies have examined the predictors of independent living skills among AD patients. The purpose of this study was to examine the role of specific cognitive and neuropsychiatric symptoms in determining functional abilities among patients with mild-moderate AD. Forty-five AD patients (mean age = 77 ± 7.6, education = 11.4 ± 2.7, MMSE = 22 ± 3.4) were administered the Mattis Dementia Rating Scale (MDRS) and the Frontal Lobe Personality Scale (FLOPS). Caregivers completed a modified form of the Lawton and Brody Activities of Daily Living Questionnaire, an instrument designed to assess both basic (BADLs) and instrumental activities of daily living (IADLs). We hypothesized that: (a) executive and memory abilities, as measured by the MDRS, would contribute significantly to the prediction of IADLs in AD, and that (b) apathy, as measured by the FLOPS, would add significantly to the prediction of IADLs, over and above the contribution made by cognitive variables. Multiple regression analyses revealed that executive and memory abilities accounted for 26.4% of the variance in IADLs ($p < .03$) and apathy accounted for an additional 26% of the variance ($p < .01$). Thus, the total variance accounted for by the model was 52% ($p < .01$). Apathy was the only significant predictor of BADLs ($p < .03$). These results suggest that cognitive and neuropsychiatric impairments contribute uniquely to functional disability in patients with AD.
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H. CHAGIGIORGIS, S. MURTHA, V. WHITEHEAD, & H. CHERTKOW. Improving Attention in Alzheimer's Disease After 6 Months of Aricept Treatment.
Background: The purpose of this study was to determine the effects of Aricept (acetylcholinesterase inhibitor increases the availability of acetylcholine) on attention in SS with Alzheimer's disease (AD). *Method:* After 6 months of treatment on the drug, patients were labeled as responders (R) to the drug or nonresponders (NR) based on separate evaluation of their maintenance or improvement on tests of general cognitive ability (e.g., Mini Mental Status Exam). At Time 1 (prior to drug treatment), and Time 2 (after drug treatment), patients were administered 2 tests of focused attention: The Stroop Color Naming Task (SCNT; $n = 21$) and the Stroop Picture Naming Task (SPNT; $n = 25$). *Results:* Analyses of the performance time and errors made for both tasks revealed the expected main effect of Condition with an increase in time to perform the task and greater errors made for the more difficult conditions. The Interference effect (a measure of how much the more difficult condition impaired focused attention relative to baseline performance on the task) did not differ between the groups or across time on either version of the Stroop task. Interestingly, the NRs tended to perform faster on the SPNT than Rs but also made more errors. *Conclusion:* It appears that enhancing the availability of acetylcholine was effective in maintaining performance time and decreasing errors made on tests of focused attention in the responders but not the nonresponders.
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S. AUCHTERLONIE & N.A. PHILLIPS. The Nature of Naming Deficits in DAT Patients: Evidence From a Semantic Battery.
Semantic memory impairment is commonly observed in patients with dementia of the Alzheimer type (DAT); however the nature of the impairment is unclear. Naming deficits are often taken as evidence for deterioration of semantic memory, yet there is still debate as to whether a naming deficit reflects an impairment in object recognition due to semantic memory loss or an impairment in word retrieval. The present study was designed to evaluate the nature of naming deficits in patients with DAT. A semantic battery was developed for a pool of pictures chosen to elicit

naming errors in DAT patients on approximately 50% of the items. Four semantic questions were created for each picture; questions focused on physical features and other general semantic knowledge. The battery was administered to elderly controls and patients with DAT to determine whether a failure to name a certain item was relative to impaired knowledge of that item. As expected, elderly controls were able to name most pictures and had a near-perfect performance on the semantic battery. DAT patients were unable to name approximately half of the pictures and their performance on the semantic battery was poorer than that of the elderly controls. Naming success and semantic battery performance on individual items was also used to examine semantic priming effects measured with reaction time and event-related brain potentials. The results are discussed in terms of current hypotheses of anomia and semantic memory deficits in DAT.
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K. WILD, J. KAYE, & M. BALL. The Severe Impairment Battery and Clinicopathologic Correlations in Alzheimer's Disease.
In recent years, several instruments have been developed to assess cognitive functioning in severely impaired dementia patients. The stated aims of these measures have been to extend downwards a range of cognitive domains comparable to those addressed by more complete neuropsychological batteries that are typically administered to dementia patients, and to provide the opportunity for a closer temporal relationship between neuropsychological assessment and autopsy. The Severe Impairment Battery (Saxton et al., 1990) has been shown to be a particularly sensitive assessment tool in patients with the most severe degree of dementia (MMSE 0–5). However, the association between neuropathological findings and performance on the Severe Impairment Battery has not yet been described. The present study was conducted to examine the relationship between burden of neuropathologic lesions and cognition in severely impaired AD patients. The sample consisted of 58 patients with autopsy confirmed Alzheimer's disease. All subjects had been administered the Severe Impairment Battery at least once prior to death. Semiquantitative neuropathological analyses provided measures in 6 neocortical areas and 7 limbic areas; summary neurofibrillary tangle (NFT) and senile plaque (SP) scores for neocortical and limbic areas were derived. The average interval between last clinical assessment and death was 20 months. Subjects had a mean MMSE of 5.1 at the time of their last assessment. SIB scores were found to be significantly correlated with neocortical NFT ($p < .01$) but not SP. This association did not hold for limbic NFT or SP.
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S. DUFF-CANNING, L. NGO, L. LEACH, D. STUSS, & S. BLACK. Diagnostic Utility of Difference Scores on Animal *vs.* Letter F Fluency in AD.
Impaired semantic relative to phonemic fluency has been reported in Alzheimer's disease (AD), but the evidence is inconsistent. Discrepant results may be due to methodological differences among studies, including small samples, varying dementia severity, and type of fluency task. The present study investigated the utility of difference scores between animal and letter F fluency, tests commonly used in the memory clinic setting, for discriminating AD from normal controls. Performance was evaluated in a large sample of AD patients ($n = 112$) diagnosed using NINCDS-ADRDA criteria and grouped by dementia severity from very mild to moderate on Mattis Dementia Rating Scale scores and compared to mild cognitive impairment (MCI, $n = 32$), vascular cognitive impairment (VCI, $n = 8$), vascular dementia (VaD, $n = 15$), and normal elderly controls (NC, $n = 48$). ANCOVAs controlling for age and education revealed significant overall group differences on both raw and difference scores. MCI, AD, and VaD groups generated fewer animal names than NC. All groups generated fewer F words than NC except MCI and very mild AD. NC exhibited larger difference scores (animal > F) compared to AD and MCI, but not VCI and VaD. Within AD, standardized difference scores decreased with increasing dementia severity ($r = -.38$, $p < .001$) due to greater decrements on animal relative to F fluency. ROC curves showed animal fluency (AUC = .95) was superior to both difference scores (AUC = .77) and F fluency (AUC = .78) in discriminating AD from NC. Although difference scores distinguished between AD, dementia with vascular etiology, and NC, semantic fluency itself was more useful for detection of AD.
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G. SMITH, J. CERHAN, & R. IVNIK. Diagnostic Utility of Select WAIS–III/WMS–III Indices for Alzheimer's Disease.
To predict group membership, we conducted stepwise logistic regression on WAIS–III/WMS–III Verbal Comprehension, Perceptual Organization, Visual Immediate Memory, and Auditory Delayed Recall scores from 35 Alzheimer's disease (AD) patients and 145 age and education matched normals from the The Psychological Corporations' standardization sample. In spite of the significant group mean differences across all measures, Verbal Comprehension and Perceptual Organization did not enter the model. Auditory Delayed Recall entered the logistic model first and was followed by Visual Immediate Memory. This logistic model has substantial diagnostic accuracy (maximal hit rate of 97.1%). These findings support the calculation of likelihood ratios (LR) with these memory indices. Likelihood ratios for ranges of the summed Auditory Delayed plus Visual Immediate score were subsequently calculated. Summed index scores less than 150 provide a very high likelihood ratio (LR = 48.4). Conversely, summed scores above 170 provide very low likelihood ratios (LR = .3). These findings provide preliminary support for the diagnostic utility of these WMS–III indices. However, the AD group in this analysis had well established disease. Further analyses with milder patients and to establish utility in differential diagnosis were warranted.
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J. GALLO, J. DE VRIES, N. DUDA, C. CLARK, & G. GLOSSER. Visuoperceptual Functions Predict Activities of Daily Living in Dementia Patients.
Neuropsychological data have been shown to be useful for diagnosing cognitive dysfunction in dementia patients and for predicting functional capacities for activities of daily living (ADLs). Prior investigations have focused primarily on relationships between memory and executive control deficits and ADL performances in neurologically impaired patients. Visual perceptual deficits, common to many dementia patients, constitute another neuropsychological domain that may also disrupt ADL performances. We assessed the relationship of various visual perceptual functions to ADL performances in a heterogeneous group of 35 elderly patients with neurodegenerative disorders, most diagnosed with probable Alzheimer's disease. Patients completed tasks tapping visual perceptual functions believed to be mediated principally by occipital lobe structures (shape discrimination), posterior inferotemporal regions (face, object form, and written letter discrimination) and superior parietal lobe areas (spatial localization). Performance of various ADLs was rated by a knowledgeable caregiver. Object discrimination performances were found to correlate significantly and specifically with the performance of visually based ADLs (e.g., bumping into things or misreaching for objects), but not other ADLs, when the variance attributable to dementia severity, language disturbance, and other visual perceptual abilities was controlled. These results highlight the important contribution of bilateral inferotemporal visual perceptual processes for the performance of ADLs in elderly patients with neurodegenerative dementia.
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C. HALPERN, C. McMILLAN, K. DENNIS, P. MOORE, & M. GROSSMAN. Calculation Impairment in Neurodegenerative Diseases.
We examined calculation in patients with Alzheimer's disease (AD; $n = 14$), frontotemporal dementia (FTD; $n = 13$) and corticobasal degeneration (CBD; $n = 9$). Our calculation model involves at least 3 components: numerosity, combinatorial processes, and executive resources such as working memory. We assessed oral calculation of addition, subtraction, multiplication, and division involving smaller numbers (≤ 5) and larger numbers. Calculation errors were analyzed qualitatively, including: sign error, math table error, random error, and no response. We also assessed dot counting for smaller numbers (2–5) *versus* larger numbers (6–9) and executive measures (oral trails, reverse digit span). CBD (31% correct) demonstrated an overall impairment in oral calculation compared to AD (78% correct) and FTD (63% correct) [$F(2,32) = 5.03$; $p < .01$ co-varied for MMSE]. However, FTD were as impaired as CBD [$t(20) = .69$; n.s.] for the most resource-demanding condition—division with larger numbers. Error analysis showed that CBD make more "random errors" [$t(21) = 2.00$; $p < .06$] than AD and more "math table errors" than FTD [$t(20) = 2.06$; $p < .05$]. CBD also have more "no responses" than AD [$t(21) = 3.79$; $p < .001$] and FTD [$t(20) = 2.75$; $p < .01$]. CBD (65% correct) had more difficulty counting dots than AD patients (92% correct) [$t(21) = 3.07$; $p < .01$], suggesting a numerosity deficit in CBD. Correlations between calculation and executive measures were highly significant in FTD (p's $< .005$) but were borderline or not significant in AD. Our results suggest that impaired calculation in CBD is due in large part to their limited sense of numerosity, while FTD and possibly AD patients have difficulty with executive resources used to support calculation performance.
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L. HEMMY, L.D. ROSENSTEIN, & M.P. NORRIS. Detecting Dementia Deficit Profiles in Neuropsychological Test Data.
Distinguishable patterns of deficit have been found on neuropsychological tests in patients with dementia syndromes resulting from different neuropathology. Deficits seen in temporo-parietal cortical dementias (e.g., Alzheimer's disease) *versus* frontal-subcortical dementias (e.g., Huntington's disease) is a commonly proposed distinction. Multiple lines of evidence support distinctive cortical and subcortical patterns of disease progression, and this neuroanatomical difference may be detected in neuropsychological assessment. This study evaluated whether neuropsychological tests distinguish the underlying structure of these anatomical systems of dysfunction (specifically nonfrontal cortical, subcortical, and frontal systems). Participants were 107 outpatients over 55 years old, mostly referred for differential diagnosis of dementia. Data from a battery of common neuropsychological tests were entered into a maximum likelihood estimation confirmatory factor analysis. Six models were compared using the χ^2 difference test and multiple fit indices: 2 models of deficit patterns seen in cortical *versus* subcortical dementia, 3 models of cognitive domains commonly found in factor analytic studies, and a single-factor solution. The best fit was a 5-factor model of cognitive domains (speed/concentration, visual-perceptual, verbal, learning/retention, and executive functions/working memory), and was a significantly better fit than either of the deficit-based models. Four of 6 commonly used fit indices fell within an acceptable range for this model. Although only 2 of 4 fit indices for a cortical/subcortical/frontal model fell in the acceptable range, this 3-factor deficit model produced a better fit than the remaining models of cognitive domains.
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T. ANTOLIN, J. WEN, B. CHOI, S. BERMAN, & M. MITRUSHINA. Physiological Markers of Early DAT.
Physiological markers of early dementia of Alzheimer's type (DAT) were explored. Visual event-related potentials (ERPs) were compared for 6 participants in the early stages of DAT (based on NINCDS/ADRDA criteria), and 6 healthy elderly. Groups were matched for age ($M = 67.0$ and 72.5) and education ($M = 12.3$ and 12.4) for DAT and control groups, respectively. Stimuli for a visual CPT task consisted of different shapes (circles, squares, triangles), colors (red, blue, yellow) and numbers (0 to 9) presented with an ISI of 2 s on a computer monitor. Twenty percent of the stimuli were identical for 2 consecutive trials in shape, color, and number, and were categorized as targets. EEG was recorded across 32 scalp sites, but for the purposes of this paper only the data for the Fz, Cz, and Pz electrodes were used. Amplitude and latency of P200 and N200 components for the ERPs in response to target stimuli were analyzed. Results indicated that the N200 amplitude was significantly greater for the DAT group in comparison to the controls at electrode sites Pz and Cz ($p < .05$). P200 amplitude at Fz was also significantly different for the 2 groups ($p < .05$), with DAT participants showing lower amplitudes. Literature indicates that parameters of the N200 potential in response to target stimuli are not expected to change with advanced age. Therefore, this ERP pattern shows promise as a diagnostic marker for early DAT.
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L. LEACH, D. REWILAK, & B. RICHARDS. The Kaplan Baycrest Neurocognitive Assessment's Sensitivity to Dementia.
The Kaplan-Baycrest Neurocognitive Assessment (KBNA) is a battery of tests of cognitive ability developed to assist in the identification of cognitive disorders due to brain dysfunction. We present data on the ability of the KBNA to differentiate a group of clinical with dementia patients (Group D) from a nonclinical control sample (Group NC). Group D consisted of 33 individuals who met criteria for dementia. The clinical diagnosis for Group D was as follows: progressive supranuclear palsy 1; Alzheimer disease 17; vascular dementia 7; Lewy body disease 6; and primary progressive aphasia 2. Group (NC) was drawn from the original KBNA standardization sample matched to Group (D) on age and education. A multivariate analysis of variance revealed that Group D obtained significantly lower scores ($p < .05$) on all 8 of the primary KBNA indices than did Group NC. A cut-off score based on the total of the index scores correctly classified 92% of the 2 groups with a sensitivity of .88 and specificity of .97. The positive and negative predictive values were .97 and .89, respectively, for the prevalence (.50) of dementia in the sample. For prevalences ranging from .10 to .90, positive predictive value ranged from .76 to .99 and negative predictive value ranged from .99 to .47. The KBNA was found to have significant clinical usefulness at identifying the presence of dementia. Given the observed predictive values, the KBNA will prove to be especially useful at identifying individuals in specialty memory disorder or dementia clinics.
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J. ANDRIKOPOULOS & K.K. ZAKZANIS. Factor Analysis of the WAIS–III in Alzheimer's Disease.
To date, the factor structure of the WAIS–III has not been studied in patients with Alzheimer's disease. The prorated WAIS–III was administered to 153 patients diagnosed with Alzheimer's disease. There were 5 subtests in the first factor with the following loadings: Digit Symbol Coding (.85), Block Design (.80), Picture Completion (.77), Matrix Reasoning (.73), and Arithmetic (.59). Four subtests made up the second factor as follows: Vocabulary (.87), Information (.83), Similarities (.78), and Digit Span (.57). As expected, the principal components factor analysis generally revealed a 2-factor verbal and performance model that explained 65.93% of the variance.
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J. ANDRIKOPOULOS & K. ZAKZANIS. The Effects of Mood Symptoms on Cognition in Alzheimer's Disease.
Research regarding the effects of depression on cognition in Alzheimer's disease is mixed. Part of the difficulty in assessing depression arises from the nature of the symptoms. While some research suggests that depression is common in Alzheimer's disease, others have found that "depression" is accounted for by neurovegetative symptoms reflecting organic personality changes rather than clinical depression *per se*. This study examined the effects of mood symptoms on cognition in Alzheimer's disease. The Geriatric Depression Scale (GDS) was administered to 255 patients diagnosed with Alzheimer's disease. Ten GDS items were identified in 2 separate factor analytic studies as reflecting mood symptoms associated with depression. Patients denying all mood symptoms ($N = 108$) were compared to patients who acknowledged 1 or more symptoms ($N = 147$). There was no statistically significant difference between groups on measures of attention (Digit Span & Symbol Digit Modalities), memory (Logical Memory I & II & Visual Reproduction I & II), language (Visual Naming, Controlled Oral Word & Token Test) or tests of visuocognitive abilities (Judgment of Line Orientation, Facial Recognition Test, & Three-Dimensional Constructional Praxis). When the same analysis was done comparing patients without mood symptoms *versus* those scoring at the 75th percentile (acknowledging 3 or more mood symptoms; $N = 64$), the same results were obtained. Mood symptoms appear to have a minimal effect on cognition.
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J. KLEINER, K. GROHMAN, J. STRANG, K. DONNELLY, A. ROSEN, & E. LOVALLO. Differential Diagnosis of AD, VaD, PD, and Mild Cognitive Impairment Using the Clock and DRS.
The Clock Drawing Test has been cited as a powerful measurement tool in assessing neuropsychological disorders, visuoconstructive abilities, symbolic representation, and executive functioning. The present study examines the Clock Drawing Test's utility in differentiating between patients with vascular dementia ($n = 20$), Alzheimer's disease ($n = 21$), Parkinson's disease ($n = 16$), and mild cognitive impairment ($n = 22$). Clocks were coded by 3 independent raters based on critical features of the number placement, hand setting, and centers of the clocks, as defined by Freedman, Leach, & Kaplan et al. (1994). Clock scores were also compared to subscale and overall scores on the Dementia Rating Scale. A one-way analysis of variance (ANOVA) indicated that the combined score of hand criteria significantly differentiated between groups ($p = .039$), as did combined number criterion ($p = .047$) and total clock score ($p = .032$). Number criteria significantly differentiated between MCI and PD ($p = .035$), while hand criteria differentiated between AD and MCI ($p = .039$). A hierarchical linear regression indicated the clock significantly predicted DRS performance above and beyond age, sex, and education ($R^2\Delta = .161$, $p = .007$). The individual effect of the combined score for hand setting criterion was significant ($\beta = 3.594$, $p = .003$), indicating that the hand placement on the clock test is the most sensitive criterion. The total DRS score ($p < .001$), Attention subscale ($p = .05$), Initiation/Perseveration subscale ($p < .001$), Conceptualization subscale ($p < .001$), and the Memory subscale ($p < .001$) significantly differentiated among groups. Specific clock criteria were also examined using chi square analyses, as were individual correlations. The predictive value of the Clock Drawing Test, coupled with the DRS, was also examined. Implications for differential diagnosis and future research are discussed.
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R.H. FULLER, D.K. KENDALL, S.E. NADEAU, A.B. MOORE, K.M. HEILMAN, & L. J. GONZALEZ-ROTHI. Indicators of Success in Cognitive-Cholinergic Therapy in Alzheimer's Disease.
Donepezil is a cholinesterase inhibitor in common usage with patients with Alzheimer's disease worldwide with the assumption that it may slow the progression of cognitive decline. We have previously reported a case in which errorless learning treatment techniques combined with donepezil boosted lexical retrieval retention over the yield of drug alone (Fuller et al., 2001). Animal studies have shown that donepezil increases cortical plasticity, and the assumption was that the use of errorless learning maximized the opportunity for this potential structural change to offer a functional impact not seen with the drug alone. While we have shown that this combination has, at least once, been very effective, we recently had the opportunity to use these methods with a second subject who did not respond at all to the treatment combination (drug plus therapy). Thus, the purpose of this report is to review the pretreatment differences (social, psychological, and medical) between these 2 subjects (responder *vs.* nonresponder) to begin to explore conditions that might influence responsiveness with the hope of creating effective (*a priori*) inclusion and exclusion criteria for entry into this type of treatment regimen. Subject 1 (responder) and Subject 2 (nonresponder) were similar in level of education and degree of aphasia, but were different in gender, presence of spouse, place of residence (e.g., institution *vs.* home), degree of cognitive decline, and type of medication. These results are discussed in terms of exploring conditions (social, psychological, and medical) that might predict success in this type of treatment regimen.
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K.K. ZAKZANIS, J. ANDRIKOPOULOS, & D.A. YOUNG. Neuropsychological Differentiation of Late-Onset Schizophrenia and Dementia of the Alzheimer's Type.
Late-onset schizophrenia and dementia of the Alzheimer's type (DAT) often present with some pathological and behavioral commonalities. Specifically, both illnesses may involve varying degrees of delusional manifestation, apathy, lateral/third-ventricular enlargement, reduced frontal lobe activity, hippocampal atrophy, and dopamine imbalance. Moreover, patients with late-onset schizophrenia and DAT have shown comparable cognitive impairment on standardized neuropsychological tests. As such, a differential diagnosis of the 2 disorders on the basis of such testing can sometimes prove difficult. The present study evaluated the neuropsychological test results of 32 patients with late-onset schizophrenia and 32 patients with DAT, to distinguish what neuropsychological measures best differentiate the 2 disorders. We present a neuropsychological profile of effect sizes and test overlap values that rank-order the sensitivities of a battery of neuropsychological measures in terms of their capability to discriminate between patient groups. More specifically, we found that the WAIS–R Similarities subtest and the California Verbal Learning Test (both short and long delay free recall) correspond to the most sensitive diagnostic neuropsychological measures that can aid in the differentiation between patients with late-onset schizophrenia and DAT.
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M. AGUILAR, S. ZARAGOZA, D. BADENES, N. CERULLA, G. CHICO, O. GELONCH, S. RAMOS, S. PILES, & A. ROJO. Alzheimer's Disease, Lewy Body Disease: Function, Personality, and Behavior.
Alzheimer's disease (AD) and Lewy bodies disease (LBD) progress through several stages featured by changes in the functional cognitive and behavioral areas. *Aim:* To verify if the series of AD patients studied by our group follow the classical progression pattern we assessed if there are differences between the progression pattern among dementia subjects (AD presenile, AD senile, and LBD) in relation to the functional cognitive and behavioral areas. *Methods:* We assessed 398 patients (9.5% presenile, 61% senile, and 29.5% LBD) using the Mini-Mental State Examination (MMSE) for cognition, GDS for stage, and the Blessed Scale and RDRS2 for function and behavior. *Results:* Patients with AD presenile are more affected than AD senile as GDS stage increases at the same MMSE score range in relation to the Activities of Daily Living, Personality Disorders, and Habits assessed by the Blessed Scale. In relation to the RDRS, AD

presenile patients showed more need of help as was seen in the Daily Living Capacities. Patients suffering from LBD showed a more significant impairment than the other AD types in the Personality subscale of Blessed Scale and in the "physical disability" of RDRS-2. *Conclusions:* From the results there is evidence that there are different patterns related to functional capacities among EA types (senile and presenile) and LBD.
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X. ORTIZ, F. OSTROSKY-SOLIS, L.M. GUTIERREZ, S. MEJÍA, L. SANCHEZ, & S. JUAREZ. Dementia, Mental Status Test, and Education.
Some studies have reported that low educational attainment is a risk factor for dementia (Katzman, 1993; Mortimer and Graves, 1993; Stern et al., 1994). Others have not found an association between education and dementia (O'Connor et al., 1989; Beard et al., 1992; Harwood et al., 1999) suggesting that differences could be due to a test bias, because individuals with low educational attainment perform worse on tests used to diagnose dementia. Most of these tests do not consider educational levels increasing false positives. A total sample of 384 subjects (276 normal and 100 dementia), mean age of 75.01 and mean years of education of 3.82, were evaluated with the Mini-Mental State Examination, the Pfeffer, the Short Blessed Test, the Blessed Dementia Scale, and the NEUROPSI. The sample was divided into 4 diagnostic levels (normal, mild, moderate, and severe) and 4 educational levels (illiterates, 1–4, 5–9, 10–25 years of studies). Sensitivity and specificity for all instruments was established. Instruments showed a high sensitivity and specificity to diagnose dementia in subjects with high education (more than 5 years of studies). However, sensitivity and specificity diminished in subjects with low education (illiterates and 1–4 years of studies). Our data provide evidence about the importance of considering educational level when diagnosing dementia, in order to avoid false positives.
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Poster Session 3/1:00–6:45 p.m.

FRONTOTEMPORAL DEMENTIA

P. MOORE, J. RHEE, C. McMILLAN, & M. GROSSMAN. Category Membership Impairments in AD, FTD, and CBD.
A category-specific semantic impairment is seen in Alzheimer's disease (AD) for natural kinds (NK) compared to manufactured artifacts (MA). This has been interpreted to support the "distributed" approach to the neural representation of semantic knowledge, where NK knowledge involving shared features declines with disease progression. Little work has investigated other progressive neurodegenerative diseases such as frontotemporal dementia (FTD) or corticobasal degeneration (CBD). We assessed category membership decisions for NK and MA in 111 AD patients, 43 FTD patients, and 22 CBD patients with mild-to-moderate dementia. Patients made category membership decisions for 24 NK ("Is this a vegetable?") and 24 MA ("Is this a tool?"). Half the stimuli were printed words and half color pictures; half of each stimulus type was a target and half a foil. Subgroups were followed longitudinally over 12 months (AD = 45, FTD = 19, CBD = 5). Performance was converted to *z*-scores based on demographically-matched control subjects. Of AD patients, 26% were significantly impaired, while 19% FTD and 18% CBD patients were impaired in category membership judgments. Category-specific effects included a significant difference for vegetable judgments [$\chi^2(2) = 6.14$; $p < .05$]: AD patients were most impaired. Groups did not differ for tool judgments [$\chi^2(2) = 1.81$; n.s.]. CBD patients did not show a semantic category effect but were significantly more impaired for pictures than words [$\chi^2(1) = 4.25$; $p < .05$]. Longitudinally, there was a significant decline for NK and MA in AD, but FTD declined significantly only for MA. These findings show distinct category-specific effects in patients with different neurodegenerative diseases, an observation that counters the "distributed" approach.
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C.A. HYNES, C.M. O'TOOLE, P. ROY, F.Q. GAO, L.A. DADE, M. FREEDMAN, B.L. MILLER, S.E. BLACK, & B. LEVINE. Self-Regulatory Disorder in FTD: Evidence From the Revised Strategy Application Test (R–SAT).
The onset of frontotemporal dementia (FTD) is often heralded by self-regulatory disorder (SRD), or failure to regulate behavior according to internal goals and constraints. Because SRD is most apparent in unstructured situations in which neither the environment nor habit determine the appropriate response, performance on structured neuropsychological tests is often preserved. The Revised Strategy Application Test (R–SAT) is a paper-and-pencil laboratory test designed to mimic the unstructured real-life situations that pose problems for patients with FTD and other diseases affecting frontal lobe function. Data are reported for a sample of patients with FTD ($N = 16$) and matched controls. Results indicated profound impairment associated with FTD on R–SAT measures of strategic behavior and action slips. The impairment was related to measures of focal atrophy as quantified from high-resolution structural MRI. The deficits were magnified in patients retested after 1 year, supporting the R–SAT's sensitivity to dementia progression. Finally, a significant relationship between R–SAT performance and real life executive deficits [as measured by significant others' responses on the Dysexecutive Questionnaire (DEX) was observed ($r = .59$)]. As expected, patients' own ratings were attenuated relative to significant others and were not correlated with R–SAT performance. These results support the use of the R–SAT and other unstructured tests in the assessment of patients with FTD and other frontal lobe brain disease.
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K.P. RANKIN, J.H. KRAMER, P.M. MYCHACK, & B.L. MILLER. A Double Dissociation of Personality Change in FTLD Subtypes.
Disturbance of interpersonal functioning is a primary diagnostic criterion in frontotemporal lobar degeneration (FTLD), but efforts to objectively and reliably quantify such deficits are only beginning. The Interpersonal Adjectives Scales (IAS) was designed to assess interpersonal behaviors as "blends" across 2 primary axes, Dominance and Nurturance. First-degree relatives rated 44 patients (14 frontal-variant FTLDs, 12 temporal-variant FTLDs, 18 Alzheimer's) on the IAS before illness onset and currently. Both FTLD subtypes showed significantly greater increases in overall personality pathology (VL) than ADs (FV: 21.29 ± 9.40; TV: 22.50 ± 27.60; AD: 5.44 ± 12.22; $p < .05$). Compared to ADs, FVs showed significantly decreased Dominance (DOM: FV = −2.58 ± 1.9; AD = −1.30 ± 1.17; $p < .05$) but not Nurturance (LOV). TVs LOV dropped significantly compared to ADs (TV = −2.25 ± 1.97; AD = −0.38 ± 1.04; $p < .005$), but DOM showed no group differences. Subscale scores also differentiated FTLD subtypes: FVs showed a 2 *SD* increase in submissiveness (HI) (*T*-score change: 22.07 ± 13.19; $p < .001$) but no significant increase in cold-heartedness (DE), while TV's cold-heartedness increased 2 *SD*s (*T*-score change: 19.00 ± 21.04; $p < .01$) but submissiveness did not increase. Both FTLD groups showed a 2 *SD* increase in introversion (FG) (*T*-score change: FV = 23.29 ± 17.54; $p < .001$; TV = 19.17 ± 17.98; $p < .005$). AD controls showed smaller but significant increases in introversion (*T*-score change: 8.50 ± 9.56; $p < .005$) and submissiveness (10.17 ± 11.66; $p < .005$), but unlike FTLDs, current scores remained within the normal range. Thus, the IAS differentiated FTLDs from ADs

and distinguished distinct patterns of personality change in the subtypes of FTLD, with FVs evidencing a pattern of extreme loss of social dominance but only mild loss of nurturance, and TVs showing the reverse pattern.
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K.P. RANKIN, J.H. KRAMER, P.M. MYCHACK, & B.L. MILLER. Differential Patterns of Empathy Loss in Frontal and Temporal Variants of FTLD.
Subjective descriptions suggest empathy loss may be one aspect of interpersonal dysfunction in frontotemporal lobar degeneration (FTLD). There are multiple cognitive and affective functions underlying empathy, but theory suggests empathy is partly linked to the ability to spontaneously generate ideas (e.g., about another's experience). We hypothesized that FTLD patients would show significantly lower levels of empathy than AD patients, and that this effect would be partly mediated by decreased spontaneous generation on neuropsychological testing. First-degree relatives rated 35 patients (12 frontal-variant FTLD, 11 temporal-variant FTLD, and 12 Alzheimer's), before illness onset and currently, with the Interpersonal Reactivity Index (IRI), a measure of both cognitive and emotional components of empathy. Three generational fluency measures (animals, phonemic fluency, design fluency) were also administered. Groups did not differ significantly on MMSE, premorbid empathy, or generation scores. FVs had significantly lower emotional empathy (emotional concern, or EC) (19.50 ± 8.49) than ADs (28.17 ± 3.88; $p < .05$). TVs had lower EC (18.27 ± 9.67, $p < .01$) and lower cognitive empathy, including perspective taking (PT) (TV = 11.64 ± 4.7; AD = 19.67 ± 5.96; $p < .05$) and fantasy (FS) (TV = 12.82 ± 3.74; AD = 18.25 ± 4.43; $p < .05$) than ADs. Generation accounted for 26% of FS variance and 24% of PT variance ($p < .005$). Diagnosis no longer significantly predicted cognitive empathy scores when the effects of generation were removed. However, diagnosis remained able to predict EC scores (16%, $p < .01$), even removing the effects of generation (23%, $p < .005$). Thus, FVs lost emotional empathy compared to ADs, and TVs lost both emotional and cognitive empathy. Consistent with theoretical models, generational fluency strongly influenced cognitive empathy, but played a smaller part in emotional empathy.
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A. JEFFERSON, P. MOORE, C. McMILLAN, K. DENNIS, & M. GROSSMAN. Verbal Fluency in Frontotemporal Dementia, Alzheimer's Disease and Corticobasal Degeneration.
Verbal fluency, a measure of mental search through the lexicon involving executive control guided by a letter (FAS—phonemic) or a semantic category (Animals–category), is thought to differ among dementia patients. Task demand variations make results difficult to interpret. We examine category and phonemic fluency performance in Alzheimer's disease (AD; $n = 29$), corticobasal degeneration (CBD; $n = 13$), and frontotemporal dementia (FTD; $n = 22$) using an ANOVA of *z*-scores based on age-matched healthy elders ($n = 15$). A main effect for task [$F(1,61) = 131.97$; $p < .0001$] shows reduced semantic compared to phonemic fluency for all 3 patient groups. A group-by-task interaction [$F(2,61) = 22.90$; $p < .0001$] shows that AD patients [mean $z = -4.57$; $t(50) = 4.86$; $p < .0001$] and CBD patients [mean $z = -4.11$; $t(33) = 2.76$; $p < .009$] produce less category output than FTD patients (mean $z = -2.67$), while CBD patients [mean $z = -2.39$; $t(40) = 2.90$; $p < .006$] produce less phonemic output than AD patients (mean $z = -1.55$) but do not differ from FTD patients (mean $z = -1.92$). Analyses of FTD patient subgroups show that semantic dementia patients produce less semantic [mean $z = -4.14$; $t(3) = 21.47$; $p < .0001$] *versus* phonemic output (mean $z = -1.26$), but this difference was not evident in progressive nonfluent aphasia, executive, or social subgroups. We suggest that CBD patients have difficulty on both fluency tasks due to impaired lexical retrieval, while difficulty only for category fluency in AD and semantic dementia may be related to a semantic impairment.
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M.C. McKINNON, K.A. PHILP, A.F. CAMPBELL, N. KOVACEVIC, M. MOSCOVITCH, B.L. MILLER, S.E. BLACK, & B. LEVINE. Remote Memory Deficits in Patients with Frontotemporal Dementia: Dissociation of Episodic From Semantic Autobiographical Memory.
Interpretation of remote memory deficits in neuropsychological research should consider distinctions among various aspects of remote memory, such as memory for impersonal facts and personal autobiographical information. Within autobiographical memory, it is important to distinguish between episodic (re-experiencing specific events) and semantic (factual knowledge about oneself) memory. We used a novel interview technique to examine these components of autobiographical memory in patients ($N = 17$) with early frontotemporal dementia (FTD). The advantages of this technique include separate, reliable measures of episodic and semantic recall and standardized manipulation of environmental support (i.e., free recall and structured probing conditions). We found that relative to matched controls, FTD patients were selectively impaired on our index of episodic recall (i.e., contextual details suggestive of re-experiencing), whereas semantic recall (i.e., nonepisodic factual details) was relatively spared. Structured probing increased the number of details recalled, but did not alter the FTD patients' relative bias towards semantic details. Heterogeneity among our sample of dementia patients helped to clarify brain–behavior relationships. Certain patients with combined frontal and temporal damage demonstrated a nearly complete absence of episodic recall, even with aggressive probing. In contrast, patients with nonfluent aphasia, while producing shorter protocols, showed a more normal bias towards episodic details. These relationships were further validated with quantification of local atrophy taken from high-resolution structural MRI. FTD patients' apparent inability to re-experience autobiographical events is consistent with their profound deficits in personal and social awareness and may contribute to observed deficits in self-regulatory behavior.
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C.C. PRICE & M. GROSSMAN. Verb Similarity Test and *Pyramid and Palm Trees:* An AD and FTD Comparison.
We examined frontotemporal dementia (FTD) and Alzheimer disease (AD) patients to test the hypothesis that the neural basis for noun and verb processing differs. We monitored millisecond (ms) reaction time and percent accuracy performance *via* Macintosh powerbook using PsyScope 1.2.5 on a verb similarity task (VST; 48 items) and a widely used noun semantic task (PPT; *Pyramid and Palm Trees Test*, Howard and Patterson, 1992; 52 items). Participants were matched for age and education and included 19 nondepressed healthy seniors (NC), 18 AD, and 21 FTD patients. Mini Mental State Exam scores were equivalent across dementia groups ($p = 545$). The VST uses a forced-choice, 2-alternative format based on low to high synonym frequency and ranked responses of 109 undergraduate students. VST items were matched for frequency and familiarity. Groups differed significantly in overall ms reaction time and accuracy for both measures {e.g., PPT ms time [$F(2,52) = 17.74$, $p = .000$]}; VST ms time {[$F(2,51) = 18.25$, $p = .000$]}, with FTD performing less rapidly and accurately than AD on the VST (e.g., Tukey, $p = .002$) but not the PPT (e.g., Tukey, $p = .214$). Analyses of FTD subgroups revealed significantly worse performance on both tests in patients with language disturbances [i.e., progressive nonfluent aphasia (PNFA, $n = 5$), semantic dementia (SD, $n = 8$); e.g., $F(5,49) = 9.03$, $p = .000$] compared to executive/social subgroup ($n = 8$). On only the VST, PNFA and SD subgroups performed more slowly and less accurately than AD. These findings emphasize distinct neural substrates for processing verbs and nouns, and underline important differences among subgroups of FTD patients.
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A. HAYS, N. JOHNSON, & S. WEINTRAUB. Preservation of Reasoning in Primary Progressive Aphasia.
Demonstrating the integrity of nonlanguage functions is important for accurately diagnosing primary progressive aphasia (PPA), and distinguishing it from other clinical dementia syndromes. This is difficult with available clinical tests, however, because performance typically relies on normal language processes. To establish a convenient method for examining abstraction and conceptual flexibility in PPA, 10 items were selected from the Visual-Verbal test (Feldman and Drasgow, 1959). This test requires subjects to examine a set of 4 objects and to sort them into 2 groups of 3, each group characterized by a single shared feature (e.g., color or shape). Standard administration requires a spoken explanation but responses can also be indicated by pointing. Subjects consisted of 17 patients with a clinical diagnosis of PPA, 26 with probable Alzheimer's disease (AD), and 16 with frontal lobe dementia (FTD). Two cognitively intact control groups equivalent in age to the patient groups were also studied (Group 1 = 63 ± 6 years; Group 2 = 76 ± 7 years; $N = 20$ in each). PPA subjects were encouraged to explain their choices, but pointing responses were credited. PPA subjects did not differ from controls, either with respect to the total number of correct sorts or the number of correct shifts from one sort to the other within each of the 10 items. AD and FTD subjects both performed worse than their cognitively intact controls and the PPA subjects. These results provide further evidence for the isolation of aphasia in PPA and also provide a simple method for probing the integrity of thought in these patients.
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A. KERTESZ, W. DAVIDSON, & P. McCABE. Neuropsychological Profile of PPA Compared to AD.
Pick (1892) described progressive aphasia with lobar atrophy, and Mesulam (1982) coined the term "primary progressive aphasia" (PPA) in patients where other domains of cognition and activities of daily living were preserved for 2 years. Language and cognitive testing with the Western Aphasia Battery (WAB) and nonverbal cognitive tests in 67 clinically defined PPA patients were compared to 99 Alzheimer's disease (AD) patients matched for duration of illness. *Results:* PPA patients tended to be younger than the AD group ($\bar{x} = 66.7$ *vs.* $\bar{x} = 72.9$ years). PPA patients had significantly lower scores in all language subtests, but were not significantly different on a generalized test of dementia (Mattis Dementia Rating Scale). In a subset of patients, more complete memory and cognitive testing, including the WAIS–R and WMS, were carried out. A discriminant function analysis of patients showed that spontaneous speech fluency and delayed memory predicted 95.2% of the AD groups, 73.3% of the PPA group. The language characteristics of PPA patients indicate initial fluent anomic aphasia, but on follow-up they become mostly logopenic and eventually mute. Aphemic stuttering variety was seen in 16% of patients, and 10% were considered as having agrammatism. Behavioral abnormalities, resembling frontotemporal dementia (FTD) and extrapyramidal apraxic syndrome (corticobasal degeneration), were commonly observed on follow-up. *Conclusion:* PPA is a distinct clinical syndrome within the Pick's disease/FTD complex. Clinically defined cases have a distinct neuropsychological profile on language and memory testing.
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K.S. GIOVANELLO, M. ALEXANDER, & M. VERFAELLIE. Differential Impairment of Person-Specific Knowledge in Semantic Dementia.
We report the case S.T., a 61-year-old gentleman of superior intelligence, who presented with a 5-year history of slowly progressive word finding difficulty for proper names. MRI data showed severe left anterior temporal lobe atrophy. A detailed analysis of the integrity of his semantic system revealed naming deficits for both proper and common names. ST also showed severe impairments in person-specific semantic knowledge, but preservation of knowledge for famous places and common objects. ST's semantic knowledge deficit for people emerged whether he was tested with the faces or the names of famous individuals. We argue that variables which affect name retrieval such as familiarity, age of acquisition, and frequency of concept encounter, do not completely account for the selective impairment of person-specific knowledge evidenced by S.T. Instead, we emphasize qualitative differences between the nature of knowledge representations for people and for common objects. Possible neural mechanisms leading to a selective deficit in semantic knowledge of people are discussed.
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N. JOHNSON, S. HELLER, L. HERZOG, & S. WEINTRAUB. Neuropsychological Impairments in Amyotrophic Lateral Sclerosis.
Traditionally, patients with motor neuron disease (MND) have been considered free of cognitive impairment. However, newer findings in the literature have shown an association between cognitive impairment and MND, but the incidence and neuropsychological characteristics of the impairment have not been well-suited. This study examined neuropsychological functioning and behavioral impairments in a series of subjects followed in the Northwestern Movement Disorders Clinic with a diagnosis of amyotrophic lateral sclerosis. All subjects who were physically able to complete the neuropsychological battery were eligible to participate, and subjects were not selected on the basis of the presence or absence of cognitive or behavioral impairments. Over a 6-month period, 30 subjects were referred to the research study and a total of 15 subjects agreed to participate. None of the subjects were found to have impairments on tests of memory, language, or visuospatial abilities. However, 6 subjects (40%) demonstrated mild to moderate impairments on tests of executive functions. No systematic difference in the extent of bulbar involvement was identified between the subjects who showed executive function impairments and those who did not. Of the 6 subjects with executive function impairments, only 1 subject was characterized as having behavioral disturbances by caregiver ratings. These results suggest that subtle changes in executive functions may be present in a proportion of ALS subjects. Follow-up testing is in progress to determine the nature of cognitive impairments over time.
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Poster Session 3/1:00–6:45 p.m.

MOVEMENT DISORDERS

M. PISKOPOS. Hallervorden-Spatz Syndrome: Neuropsychological Findings.
Research on Hallervorden-Spatz syndrome (HSS), a rare autosomal recessive neuroaxonal degenerative condition, given its rarity is sparsely published especially in cases with adult onset. Invariably, post-mortem histology findings report iron deposits in the basal ganglia (Swaiman, 1991; Taylor et al., 1996), neurochemical abnormalities (e.g., cysteine accumulation in the globus pallidus) (Perry et al., 1985) while *in vivo* radiologic investigations report iron deposition in the globus pallidus, called "eye of the tiger" signs, and substantia nigra (Angelini et al., 1992; Hickman et al., 2001; Kim et al., 1993; Tiamkao et al., 2000). Clinically, it is characterized by extrapyramidal dysfunction and progressive intellectual impairments. In adults, the literature shows that HSS varies in its clinical presentation. There is no research literature on the neuropsychological presentation or the progressive neuropsychological deterioration in HSS given its worldwide rarity. This study presents findings of the clinical presentation and serial neuropsychological test findings in a 37-year-old male with HSS (established on the basis of *in vivo* radiological findings and a previous post-mortem diagnosis in a sibling). The findings showed progressive physical, behavioral, and neuropsychological deterioration with end-stage

dementia that were consistent with increased neural involvement observed on repeated radiologic findings.
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P. MATTIS, D. ZGALJARDIC, & A. FEIGIN. Neuropsychological Performance in Presymptomatic HD Gene Carriers.
Huntington's disease (HD) is an inherited disorder, for which progressive neuropsychological (NP) decline is a prominent feature. Clinical onset is based predominantly on motor symptomatology. The current project reports NP performance of 10 presymptomatic carriers of the HD gene [age = 48.3 ± 11.4 years (*M*/*SD*): education = 14.3 ± 1.9]. NP data for each task was compared to normative data. A cutoff suggesting impairment was set at 1.5 standard deviations below the mean. All subjects performed well on measures of language (BNT, COWA, & Tokens) and visuospatial processing (Judgment of Line Orientation, Facial Recognition, Hooper, & Rey Copy). However, performance below cutoff was observed on measures of memory [CVLT total ($N = 3$)] and attention [Brief Test of Attention ($N = 4$); IVA Attention ($N = 3$); and IVA Response Control ($N = 2$)]. There were few discrepancies based on normative data for the following tests: Rey Osterrieth delay ($N = 1$), Symbol Digit Modality ($N = 1$), Stroop color/word ($N = 0$), Trail Making ($N = 0$), and the Purdue Pegboard bilateral ($N = 1$). NP performance was variable across individuals. The majority of scores identified as impaired were produced by a limited number of subjects. Three subjects were below cutoff on 5 or more tasks, 3 subjects were impaired between 2 and 4 tasks, and 4 subjects were impaired on 1 or no tasks. This qualitative analysis supports previous research that suggests cognitive difficulties can precede the onset of motor dysfunction in HD, but also highlights the variability in cognitive presentation in this patient population.
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M. BENJAMIN, E. ARROYOS, B. McDOWELL, M. NANCE, P. COMO, J. PAULSEN, & the HUNTINGTON STUDY GROUP. Neuropsychological Performance in Juvenile Onset Huntington's Disease.
Thirty-seven patients diagnosed with juvenile onset Huntington's disease (HD) were evaluated at 22 Huntington Study Group sites using the Unified Huntington's Disease Rating Scale (UHDRS). This collaborative effort is the largest group of patients diagnosed with juvenile onset Huntington's disease to date. Subjects were given a diagnosis of unquestionable HD at an age less than 20 years based upon the UHDRS standard neurological examination ($M = 15.8$ years). Subjects ranged across the 5 stages of HD, with the majority of the group belonging in Stages 2 or 3 of the disease. The group's mean age at the time of UHDRS evaluation was 20.2 (range 10–34 years). Subjects were administered the letter fluency test, the Symbol Digit Modalities Test, and the Stroop Color Word Test in order to evaluate degree of neuropsychological impairment. The mean standard score for verbal fluency was 61.0 ($SD = 13.5$). The mean standard score for Symbol Digit was 53.9 ($SD = 24.2$). The mean standard scores for the Stroop Color Word test were the following: Stroop Color = 67.3 ($SD = 19.1$); Stoop Word = 60.9 ($SD = 19.4$); Stroop Interference = 69.6 ($SD = 18.4$). This sample demonstrated significant neurocognitive dysfunction on each of the 3 neuropsychological tests. Continued analyses will determine which of the neuropsychological instruments reflects the most impairment in the earliest stages of HD, the most sensitivity to measure the progression of neuropsychological dysfunction, as well as the most feasibility for administration throughout the duration of the illness.
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K. RYDER, S. GONTKOVSKY, K. McSWAN, J. SCOTT, K. BHARUCHA, & W. BEATTY. Cognitive Function in Parkinson's Disease: Association With Anxiety.
To re-examine the relationships among depression, anxiety, and cognitive impairment in Parkinson's disease (PD), 27 male patients with idiopathic PD were recruited from the Movement Disorders clinic at an urban VAMC. They received a neurologic examination, the Beck Depression Inventory, the Chicago Multiscale Depression Inventory, the State-Trait Anxiety Inventory, the Mini-Mental State Examination (MMSE), and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). The RBANS generates separate indexes for immediate memory, delayed memory, language, attention, visuospatial function, and a summary score (Total). Contrary to some earlier studies, measures of depression, even those that separated mood from somatic symptoms, were not correlated with any measure of RBANS performance. By contrast, measures of anxiety were significantly and negatively correlated with all cognitive measures. For example, Trait Anxiety alone accounted for 42% of the variance in the Total score; the combination of MMSE and Trait Anxiety accounted for more than 70% of the variance in the Total score. Neurologic measures were negatively correlated with some cognitive variables, but only disease duration and 1-dopa dose moderately increased the accuracy of prediction of cognitive performance. Because anxiety and depression are partially overlapping psychiatric disorders, inconsistent reports concerning the relationship of depression and cognition in PD may have arisen because different studies included varying proportions of depressed patients who were also highly anxious. Regardless of whether this speculation is correct, anxiety is a potent and negative influence on cognition in PD.
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S.A. WYLIE, J.A. BAILEY, & J.C. STOUT. Distractor Influences on Response Selection Speed in Parkinson's Disease.
Recent models of basal ganglia function implicate a role in response selection, especially when distracting stimuli compete for the control of responses. These models raise the possibility that individuals with Parkinson's disease (PD) may show a response selection vulnerability under conditions that involve response competition from distractors. In the current task, response selection was measured by the well-known stimulus-response compatibility (SRC) effect. A left or right pointing target arrow was presented, and subjects were instructed to make compatible (left arrow = left button press) or incompatible (left arrow = right button press) responses. To measure the effects of distractor competition, the target arrow was flanked by distractor arrows that pointed in the same (congruent) or opposite (incongruent) direction as the target (i.e., flanker effect). Previous work has shown an interaction between SRC and flanker effects such that incongruent flanker arrows slow reaction time under compatible response instructions, but facilitate reaction time under incompatible instructions. Eighteen PD and 18 healthy controls were slower to respond in the incompatible condition and on trials with incongruent flankers, and also showed the expected SRC by flanker interaction. Consistent with hypothesized PD vulnerability to response competition from distractors, a 3-way interaction was observed, indicating that response selection in PD was more strongly modulated by the presence of distractors, especially when the distractors were incongruent to the target. These findings are consistent with the response selection model of basal ganglia function, and suggest a particular influence of distractors during response selection in PD.
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W. BEATTY, K. RYDER, S. GONTKOVSKY, J. SCOTT, K. McSWAN, & K. BHARUCHA. Subcortical Dementia Syndrome of Parkinson's Disease: RBANS Analysis.
On mental status examinations, groups of equally impaired patients with subcortical [Huntington's Disease (HD), Parkinson's disease (PD)] or cortical [Alzheimer's Disease (AD)] dementias exhibit different patterns of neuropsychological deficits. Using the Repeatable Battery for Assessment of Neuropsychological Status (RBANS), classification accuracies of 90% or greater have been reported for individual patients with AD or HD. To test the generality of the RBANS classification algorithm, we studied patients with dementia (AD and PDD) and without dementia (PDND) ($N = 23$, 27, and 23, respectively). Classification accuracies were: AD = 87%, PDD = 78%, PDND = 39%. To permit comparisons among tests,

scores were transformed to *Z* scores. Comparisons of performance on subtests of the RBANS showed that all groups performed more poorly on tests that require motor skill or rapid information processing, but there were no differences among groups. Furthermore, memory performance by the PD groups was not improved by procedures that enhance encoding and facilitate retrieval. The RBANS is useful for discriminating patterns of cognitive impairment in PD and AD, but only if the diagnosis of dementia is established independent of the RBANS test results. Cognitive slowing is not specific to subcortical dementia and current concepts of memory dysfunction in PD may require re-examination.

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C. MORRISON, K. PERRINE, J. BOROD, P. KELLY, M. BRIN, & W. OLANOW. Relationship of Cognition to Select Clinical Characteristics of Parkinson's Disease.

The relationship between cognition and select clinical characteristics of Parkinson's Disease (PD) [i.e., disease duration (DD), side of motor symptom onset (SO), and age at the time of motor symptom onset (AO)] was examined. Some clinical features of PD, such as SO and DD, are indirect indicators of the degree of striatal-nigral pathology. If the cognitive changes seen in PD are the result of the disruption in the dopaminergic system that results from PD pathology, then a relationship between these clinical characteristics and performance on cognitive tests should be observed. Other PD clinical characteristics, such as AO, have been associated with an increased risk for development of cognitive impairment. Fifty-two nondemented PD Ss were administered a neuropsychological (NP) test battery that assessed a range of cognitive functions. Accounting for age at the time of testing, DD and AO were correlated with the NP variables. In terms of laterality, the sample was divided into 2 subgroups (R *vs.* L SO) and the data analyzed using *t* tests. There were no significant differences in age, education, IQ, DRS total, DD, or AO between the laterality subgroups. There were no significant correlations between the NP variables and either DD or AO. For the laterality analysis, PD Ss with L SO performed worse on judgments of line orientation as compared to the R SO group. All other *t* tests were not significant. In conclusion, there was virtually no relationship, beyond one probable chance finding, between indirect measures of striatalnigral pathology (and hence the degree of dopaminergic dysfunction) and cognition. This general failure to support dopamine as the primary neurotransmitter mitigating cognitive decline in PD is supported by functional imaging reports and by studies of evaluation relationships between other transmitters (e.g., Ach, 5HT) and cognition in PD. In contrast, the previously reported relationship between AO and cognitive decline in PD was not found.

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J. HAY, M. MOSCOVITCH, & B. LEVINE. Habit and Recollection in Parkinson's Disease, Amnesia, and Focal Lesion Patients.

Research has supported the distinction between 2 qualitatively different types of memory processes or systems. Declarative memory (recollection) has been characterized as intentional and effortful. It has consistently been shown to be impaired following damage to the medial temporal lobes (MTL) and also frontal structures if more strategic processing is implicated. Nondeclarative memory has been characterized as an unconscious, automatic basis of responding that does not rely on recollection. Our study assessed the role of different brain structures in mediating recollection and automatic memory (habit). More specifically, the role of the striatum and the MTL in memory performance was investigated by testing patients with Parkinson's disease (PD) and amnesia. Using Hay and Jacoby's (1996) extension of Jacoby's (1991) process-dissociation procedure, we were able to separate out the contribution of habit and recollection to performance within a single probability-learning paradigm. Amnesics showed the expected dissociation of impaired recollection and intact habit, highlighting the important role of the MTL in recollective processing. Mild PD patients did not perform differently than matched controls for habit or recollection, however, moderate PD patients were impaired in their ability to rely on habit and in their ability to recollect specific information. The performance of focal lesion patients supported the interpretation that PD patients have a significant deficit in automatic, habit-learning due to striatal dysfunction, while their deficit in recollection may arise from impoverished frontal lobe contributions.

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L. NORTON, C. SAVAGE, C. McCARTHY, & J. SHERMAN. Effect of Explicit Cueing on Verbal Learning Performance in Parkinson's Disease.

Studies of individuals with Parkinson's disease (PD) using the California Verbal Learning Test (CVLT) indicate that patients often fail to utilize semantic clustering strategies during learning and recall (e.g., Buytenhuis et al., 1994). The current study examined the performance of PD patients on a verbal learning task modeled after the CVLT but modified to include 3 memory conditions that varied in the degree of externally provided structure and semantic relatedness of the list items. This paradigm was previously used with PET to examine the role of prefrontal cortex in semantic clustering in healthy subjects (Savage et al., 2001). Findings indicated that semantic clustering is supported by left lateral prefrontal cortex. In this study, nondemented PD patients (M age = 60.50) were evaluated using the imaging paradigm offline. Findings revealed that PD subjects benefited from semantic structure, as measured by comparisons between free recall scores in both related and unrelated list conditions ($p < .0001$). Results also demonstrated that PD subjects benefited from the availability of explicit cueing and engaged in semantic clustering strategies to a greater extent in cued than noncued conditions ($p < .009$). Our findings are consistent with previous studies, which have shown that patients with PD disproportionately benefit from the availability of external cues during verbal learning (Knoke et al., 1998). This study is unique in its use of a paradigm validated by functional imaging. Our findings indicate that PD patients can engage semantic clustering processes, supported by left lateral prefrontal cortex, when they are provided with adequate external guidance.

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C. McCARTHY, C. SAVAGE, J. SHERMAN, & L. NORTON. Association Between Organization and Nonverbal Recall in Parkinson's Disease.

An association between organizational encoding strategies and subsequent nonverbal retrieval performance has been demonstrated in populations with frontal-striatal dysfunction (e.g., Grossman et al., 1993; Savage et al., 2000). While such an association has been inferred in Parkinson's disease (PD), this study systematically explores the relationship between organization at encoding and recall performance by utilizing a quantitative measure of organization. Nineteen nondemented PD patients (M age = 62, 58) were administered the Rey Osterrieth Complex Figure (ROCF) and 3 equivalent alternate figures (Savage et al., INS poster, 2001), counterbalanced across subjects. The figures were administered in copy and 30-min delay conditions. This study was unique in its quantification of organization using 5-point rating scale in the copy condition, with credit given when the key configural elements of the figures were drawn continuously as a unit (Deckersbach et al., 2000). A positive correlation was found between copy organization and copy accuracy ($p < .02$), and between copy organization and delayed recall accuracy ($p < .001$). A significant correlation was also found between copy organization and loss of set on the Odd Man Out Test ($p < .05$), but not on other measures of executive functioning. This study documents the association between organization and memory and suggests that poor organization in PD may be related to difficulties maintaining set.

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L. GRANDE, G. CRUCIAN, & K.M. HEILMAN. Semantic Priming in Patients with Parkinson's Disease On and Off Dopamine Medication.
Studies investigating cognition in healthy individuals have indicated a role of dopamine in the modulation of the signal-to-noise-ratio within semantic memory (Newman et al., 1984; Kischka et al., 1996). This study investigated dopamine's effects on semantic networks by testing priming in participants with idiopathic Parkinson's disease (PD) ($n = 10$) and healthy controls (HC) ($n = 8$). Each participant completed a semantic priming-lexical decision experiment involving 3 levels of semantic association: high prototypicality (e.g., gem–ruby), low prototypicality (e.g., gem–quartz), and unrelated (e.g., gem–shoe). Each PD participant completed the experiments both on and off their dopamine medication. For the HC group, comparison of response latencies across conditions revealed priming for targets of high prototypicality and no priming for targets of low prototypicality. In contrast, the PD group on medications demonstrated an overall pattern of semantic priming, but no effect of prototypicality. Additionally, the PD group off medications did not demonstrate an effect of either prototypicality or semantic relatedness. These results appear to support the hypothesis that dopamine may focus semantic activation.
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F.R. SPARADEO, D.M. MEYERSON, & M.M. MEYERSON. Comparing Alzheimer's Disease and Parkinson's Disease with a Brief Cognitive Measure.
Cognitive functioning in both Alzheimer's disease (AD) and Parkinson's disease (PD) is compromised. People with AD demonstrate significant deficits in memory functioning, which eventually progresses to global impairment. Cognitive deficits in PD are considered subtler than in AD and usually involve executive dysfunction. A brief cognitive screening battery was administered to 32 individuals with AD, 16 individuals with PD, and 18 elderly normal controls (NC). There were no differences in age between the groups. The cognitive battery consisted of a measure of simple processing speed, abstract memory, and memory retrieval speed, and 2 tests of concept formation yielding an accuracy score and a processing speed score. Two composite scores are generated: processing speed and level of performance. Statistical analysis indicates that the AD group is significantly slower than the PD group and both the AD and PD groups were significantly slower than the NC group (all ANOVA's were $p < .001$). The same results emerged when comparing level of performance, with the AD group functioning at a significantly lower level than the PD group, which was also significantly lower than the NC group. These results demonstrate that PD can be expected to result in cognitive impairment which involves slowed processing speed, impaired abstract memory, and impaired concept formation.
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E. LERITZ, B. SHENAL, G. CRUCIAN, & D. BOWERS. Differential Effects of Pallidotomy on Depression and Anxiety in Parkinson's Disease.
Parkinson's disease (PD) is a progressive neurological disorder characterized by movement dysfunction. Research has shown that almost half of all individuals with PD also experience depression. Recently, there has been a resurgence of pallidotomy techniques (unilateral surgical ablation of selected regions of the globus pallidus) to reduce adverse Parkinsonian sequelae. Previous studies have demonstrated significant improvements in motor, cognitive, and affective functioning following unilateral pallidotomy surgery. *Objectives:* The purpose of the current study was to evaluate the differential effects of pallidotomy treatment on self-report ratings of depression and anxiety. *Methods:* We compared the self-report ratings of 30 PD patients evaluated pre- and post-pallidotomy on the Beck Depression Inventory and the State-Trait Anxiety Inventory. *Results:* Results indicated that depression ratings improved following pallidotomy only for those participants who demonstrated elevated levels of depression prior to the surgery. Interestingly, individuals who demonstrated elevated levels of trait anxiety prior to surgery did not demonstrate a subsequent decrease in trait, but not state, anxious symptoms following pallidotomy. Differences due to side of lesion were not found on either of the measures. *Conclusions:* These results suggest that pallidotomy treatment may improve depressive, but not pervasive anxious symptoms in PD patients. Results are discussed in relation to past literature and current theories of subcortical affective modulation. The discussion will emphasize the importance of continued investigations of neuropsychological performance following pallidotomy treatment.
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D. JACOBS, C. LEE, P. MOORE, C. McMILLAN, & M. GROSSMAN. Ambiguity Resolution in Parkinson's Disease.
We encounter structurally ambiguous garden-path (GP) sentences daily (e.g., "While the mother walked the baby was crying"). Ambiguity resolution (e.g., deciding if the baby was walked) requires strategic manipulation (SM) of sentence material in working memory (WM). We assessed the role of SM in comprehension impairment of Parkinson's disease (PD) by asking patients to judge acceptability of GP sentences. In addition to "core" ambiguous sentences, other ambiguous sentences further stressed WM with an adjectival phrase between the ambiguous NP and the disambiguating region; or stressed grammar (gram) with a center-embedded subordinate clause between the ambiguous NP and the disambiguating region. We also presented similar but unambiguously correct and unambiguously incorrect sentences for judgment. The 300 written sentences, equal in length, were randomly ordered and presented word-by-word at 750 ms/word. Elderly controls (EC; $n = 8$; 86.6% correct) and PD ($n = 9$; 86.9% correct) were equal in unambiguous sentence judgments [$t(15) = 0.08$; n.s.]. EC were equal at judging unambiguous compared to "core" ambiguous sentences (78.2%) [$t(7) = 1.40$; n.s.] and ambiguous WM sentences (80.0%) [$t(7) = 0.78$; n.s.), but approached significant impairment at judging ambiguous gram sentences (68.4%) [$t(7) = 1.76$; $p < .1$]. EC showed a difference in judging ambiguous WM versus ambiguous gram [$t(7) = 4.8$; $p < .002$]. PD judgments of "core" ambiguous (64.2%) were worse than unambiguous sentences [$t(8) = 1.99$; $p < .08$]. PD also showed significant impairment at judging ambiguous WM (58.7%) [$t(8) = 2.49$; $p < .03$] and ambiguous gram (51.3%) [$t(8) = 4.2$; $p < .003$] compared to unambiguous sentences. PD showed no difference between ambiguous WM and ambiguous gram [$t(8) = 1.19$; m.s.]. PD patients have greater difficulty resolving structural ambiguity in sentences than controls, and this appears to be due in part to their WM limitations.
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C. LEE, M. GROSSMAN, E. ZURIF, P. PRATHER, J. KALMANSON, M. STERN, & H. HURTIG. Sentence Comprehension and Information Processing in Parkinson's Disease.
We examined whether slowed lexical access contributes to impaired sentence comprehension in Parkinson's disease (PD, $n = 32$) and elderly controls (EC, $n = 21$). Subjects judged lexicality of 414 continuously presented letter strings (including 60 related word pairs, 60 unrelated word pairs, 110 filler words, and 184 filler nonwords) at each of 3 interstimulus intervals (ISI): 500, 1100, and 1500 ms. ANOVA showed significant main effects for relatedness [$F(1,51) = 17.90$; $p < .01$], and ISI [$F(1,51) = 5.95$; $p < .05$], and an interaction effect for group × ISI [$F(1,51) = 8.91$; $p < .05$]. EC's primed for related pairs compared to unrelated pairs [$t(20) = 2.33$; $p < .05$] only at 500 ms ISI. PD patients primed at all 3 ISIs [500: $t(31) = 2.97$; $p < .05$; 1100: $t(31) = 3.22$; $p < .01$; 1500: $t(31) = 3.14$; $p < .05$]. We also assessed oral comprehension in sentences that were grammatically simple, contained a subject-relative

center-embedded clause, or an object-relative center-embedded clause in 22 of the PD patients. PD's classified as poor comprehenders ($n = 10$) based on comprehension accuracy showed priming only at the 1500 ms ISI [$t(7) = 3.56$; $p < .01$]. Good comprehenders primed most robustly at the 500 ms ISI [$t(11) = 3.99$; $p < .005$]. but also at longer ISI's [1100: $t(11) = 3.16$; $p < .05$; 1500: $t(11) = 2.63$; $p < .05$]. When PD patients were classified based on priming patterns, only PD's subgrouped as slow primers (i.e., at 1500 ms; $n = 13$) showed poor comprehension for object-related sentences compared to subject-relative sentences [$t(11) = 2.24$; $p < .05$]. Slowed information processing speed in some PD patients may limit lexical retrieval in noncanonical sentences that feature additional processing demands, resulting in poorer comprehension.

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B. HANNA-PLADDY & K.M. HEILMAN. The Role of Dopamine in Motor Learning.

While akinesia, bradykinesia, and hypometria are hallmark features of the dopaminergic deficit associated with Parkinson's disease (PD), the role of dopamine in skill acquisition remains unclear. To investigate the role of dopamine in cognitive aspects of motor programming, a group of 12 PD patients were studied "on" and "off" dopaminergic medications. Within each session, subjects were tested repeatedly on a computerized skill learning task where they were required to learn to use a track-pointer to duplicate two novel geometric designs. The task required patients to move the track-pointer with the index finger in a sequence of distal, proximal, and rightward directions in order to scroll in a specific pattern across the screen and then reproduce the designs. Although there were no differences "on" and "off" dopaminergic treatment in line lengths or time durations on the first attempt at figure reproduction, there was a significant difference between medication conditions in the duration of time required for completion of the final trials. The patients in the "off" condition failed to improve on the speed of design reproduction after several trials due to frequent inter-segment pauses, poor timing, and reduced capacity to initiate and terminate the movement of the cursor. These results support a prominent role for dopamine in the incremental learning of novel skills, and for signaling the beginning and end components of a movement.

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J.A.R. CARR, J.S. MARTZKE, M. SINDEN, C.R. HONEY, & C. BERK. Breadth and Magnitude of Cognitive Changes Following Pallidotomy Increase When Practice Is Accounted For.

Published studies of the neuropsychological consequences of pallidotomy (PVP) typically report few or no post surgical changes. However these studies may underestimate surgical effects on cognition as the pre–post designs employed do not adequately control for practice effects. We have studied PVP using a waitlist design that enables control for practice. Patients were assigned to 2 groups. The groups did not differ in disease duration, age, education, estimated premorbid intelligence or preoperative dementia level. One group ($n = 14$; RPVP = 4; LPVP = 10) was assessed, underwent PVP, and was then assessed twice more. A second group ($n = 14$; RPVP = 7; LPVP = 7) was assessed twice, underwent PVP, and was then assessed a third time. Assessments were separated by 2-month intervals. This design yields 2 change scores per subject: A surgical change score based on the difference in performance between the assessments conducted before and after surgery (this represents the pre–post design typical of existing studies), and a practice alone change score based on the difference in performance between the 2 assessments with no intervening surgery. Using only the surgical change score, statistically reliable declines were evident in psychomotor speed and verbal fluency. By Cohen's classification these effects were of a small-to-medium size. When the improvements found with practice alone were also considered, additional declines were evident in divided attention, free recall of verbal information (after LPVP), and in the organization of visual-spatial information. Surgical effects were now generally large sized. Pre–post methodologies may significantly underestimate the breadth and magnitude of the effects of pallidotomy on cognition.

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C. HIGGINSON, V. WHEELOCK, N. KHAMPHAY, C. PAPPAS, & K. SIGVARDT. The Relationship Between Working Memory and Recall in Parkinson's Disease.

Memory impairment in Parkinson's disease (PD) is often attributed to retrieval difficulty; however, another possibility is that executive dysfunction is an important mechanism of memory impairment. Indeed, executive dysfunction is common in PD and neuronal loops connect the substantia nigra and frontal lobes. Studies addressing the relationship between executive function and memory in PD have not included measures of working memory (WM). Working memory tasks have a significant executive component that involves active manipulation of information in a temporary store. The purpose of this study was to address the relationship between WM and recall in PD. Thirty-seven idiopathic PD patients completed the California Verbal Learning Test (CVLT), Wechsler Adult Intelligence Scale–Third Edition, Wisconsin Card Sorting Test, and Stroop Color-Word Test as part of a larger test battery. Correlation coefficients indicated that measures of reasoning, problem solving, encoding strategy, recall consistency, and WM were related to long-delay free recall (LDFR) from the CVLT; education and overall cognitive functioning were not. Stepwise regression analysis indicated that WM was the only predictor of LDFR, accounting for 47% of LDFR variability. Even after all variables that correlated with LDFR were entered into a regression analysis, WM accounted for significant additional variance in LDFR. These results suggest that an aspect of executive function, WM, is strongly related to recall in PD. Limited ability to manipulate information in a short-term store could interfere with either encoding (e.g., depth of processing) or retrieval (e.g., search strategy) in PD.

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C. VELEZ-PARDO & M. DEL RIO. Monoamine-Related Toxins Induce Apoptosis in Lymphocytes: Role of Caspase-3, NF-κB, p53 and c-Jun.

The destruction of dopaminergic and serotonergic nerve cells by selective application of 6-hydroxydopamine (6-OHDA); 5,6 dihydroxytryptamine (5,6-DHT); and 5,7-DHT, respectively, is a widely used tool to investigate the mapping of neuronal pathways, to elucidate function, and to mimic human neurodegenerative disease such as Parkinson's (PD) and Alzheimer's (AD). Despite intense investigations, the precise molecular signalization leading to cell death in a single cell model is still lacking. In this study, we provide experimental evidence that 6-OHDA, 5,6-DHT, and 5,7-DHT-derived toxins provoke apoptosis in PBL cells by a common oxidative mechanism involving the intracellular oxidation of toxins into quinones and production of the by-product, hydrogen peroxide (H_2O_2), which in turn triggers a specific cell death signal through caspase-3, NF-κB, p53, and c-Jun transcription factors activation in peripheral blood lymphocytes (PBL). Experimentally, we were able to integrate, using this single cell model, an ordered cascade of molecular events leading PBL cells to apoptosis by an oxidative stress stimuli (6-OHDA, 5,6-DHT/5,7-DHT) analogous to that encountered in PD brains (high dopamine oxidation turnover). These results may help to explain the molecular mechanisms of neuronal loss in some neurodegenerative disorders where oxidative stress plays a major role.

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Poster Session 3/1:00–6:45 p.m.

APHASIA AND APRAXIA

M.C. CAMPBELL & J.C. STOUT. Role of Short-Term Memory on Gambling Task Performance in Huntington's Disease.
Decision-making depends on several different component processes including attention, learning, and memory. Previous behavioral and modeling studies on the Bechara Gambling Task (BGT) with Huntington's disease (HD) subjects has indicated that performance is related to memory functioning (Stout et al., 2001; Busemeyer et al., 2001). The present study examined the relationship between performance on a computerized version of the BGT and performance on several additional measures assessing various aspects and levels of memory functioning for HD subjects. Similar to the previous study with HD subjects, performance on the BGT was moderately correlated with overall cognitive functioning on the Mattis Dementia Rating Scale ($r = .68$, $p = .06$) and was significantly correlated with the Memory subscale ($r = .70$, $p = .05$). However, only the spatial span test was significantly correlated with performance on the BGT ($r = .90$, $p < .01$). Stepwise regression analyses indicate that spatial span was the only significant predictor of performance on the BGT, and accounted for over 80% of the variance ($R^2 = .82$). These results support the hypothesis that HD performance on the BGT is affected by memory functioning, specifically by reduced short-term memory.
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L. J. ELIAS, C.L. BURTON, A. SHEERIN, & D.M. SAUCIER. Free Viewing Perceptual Asymmetries for Color Judgments.
Previous research has indicated that normals exhibit strong leftward biases during free viewing perceptual judgments of brightness, quantity, and size. When participants view 2 symmetrical objects and they are forced to choose which object appears darker, more numerous, or larger, participants usually select the stimulus with the relevant feature on the left side. The present study investigated the generality of this effect by employing color gradients. Thirty-four participants were presented with 60 trials comprised of a color comparison question (e.g., which object contains more red?) followed by exposure to 2 rectangular reversed color gradients (e.g., red-green and green-red). The gradients were presented in 3 different lengths (large = 600 pixels, medium = 500 pixels, and small = 400 pixels). Similar to the results from studies employing comparisons of brightness, quantity, or size, our sample exhibited a significant leftward bias on this task, regardless of the length of the gradient. However, the leftward bias was larger for longer gradients (61% for long, 59% for medium, and 54% for small). Despite the fact that participants needed to read instructions prior to each trial (potentially priming the left hemisphere), a highly significant leftward (right hemisphere) bias was exhibited on the task. This suggests that the free viewing perceptual asymmetries demonstrated on these tasks are the result of a right hemispheric attentional mechanism that is not specific to the type of comparison being made.
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R. HEATH, A. ROUHANA, & D. ABI GHANEM. Asymmetric Bias in Perception of Facial Affect Among English and Arabic Readers.
In this study, we examined the influence of reading direction on the left visual field bias that is observed in the perception of facial affect. We presented a 12-item free view chimeric faces test to 491 right-handed English and/or Arabic reading subjects and illiterates. The literate subjects were placed in 5 groups that represented a gradient in reading experience from left-to-right and from right-to-left: English Only, Mostly English/Some Arabic, Half English/Half Arabic, Mostly Arabic/Some English, and Arabic Only. The chimeric faces were constructed with a smiling half-face and a neutral half-face. Subjects were asked to decide which of a pair of mirror images of a chimeric face looked happier, the face with the smile to the left of the viewer, or the face with the smile to the right. All subjects demonstrated a bias for choosing the image in which the smile was to the viewer's left. The bias reached statistical significance in all but the Mostly Arabic/Some English group. Group variations within the leftward bias were such that the more English reading experience the subjects had, the more the bias shifted to the left. Illiterate subjects demonstrated an intermediate leftward bias. In summary, our results support the hypothesis that the leftward bias in the perception of facial affect originates in cerebral lateralization and is influenced by reading direction.
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M. MORAN, M. SEIDENBERG, S. SWANSON, D. SABSEVITZ, B. BELL, & C. DOW. Face Recognition and the Acquisition of Face-Semantic-Name Networks.
Bruce and Young (1986) proposed that recognition of familiar faces occurs in dissociable, serial stages. These include (1) structural encoding, (2) comparison with structural codes for known faces, (3) access to identity-specific semantic codes, and (4) access to name codes. Evidence suggests that the right and left hemispheres may be differentially involved in these stages. In particular, damage to the right temporal lobe disrupts access to structural face codes and the connection of these codes to identifying information, while left temporal lobe damage selectively disrupts access to names. This research, however, has largely examined familiar faces. The current study examined the effect of lateralized temporal lobe damage on the *de novo* acquisition and retention of a face-semantic-name network. Thirty unilateral anterior temporal lobectomy (ATL) subjects and 15 normal controls were presented with a learning paradigm pairing previously unfamiliar faces with identity information (occupation, city, name) in the form of vignettes. Right ATL subjects demonstrated impairment in face recognition and in learning cities and names for the faces. Left ATL subjects recognized faces accurately, but demonstrated impaired learning of all vignette information, with a marked difficulty learning names for the faces. Additionally, all subjects demonstrated differential recall of the semantic information, such that occupations were recalled better than cities, which were recalled better than names. The current findings thus suggest that the right and left temporal lobes are differentially involved in the acquisition of the person-identity system and that different types of identifying information are processed differently within this system.
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S. ZINN. Spatial Ability and Organizational Strategy on the Rey-Osterrieth Complex Figure.
The role of spatial ability in construction tasks such as the Rey Osterrieth Complex Figure (ROCF) has been examined predominantly using correlations with the Block Design subtest of the WAIS. In this study using normal young adults, spatial ability was measured by a test of spatial visualization, Thurstone's Concealed Figures (TCF) test. Linear regression was used to model the effects of spatial ability in conjunction with organizational quality on accuracy and recall scores on the Rey Osterrieth complex figure. Male students taking an introductory psychology class ($N = 52$), with normal neurological histories, were administered the TCF and the ROCF. Organizational quality was scored using a revision of Hamby et al.'s (1993) criteria. Spatial ability was highly correlated with organizational quality ($r = .42$; $p = .0017$). In a linear model of copy accuracy score [$F(2,50) = 10.95$; $p = .0001$], both spatial ability and organizational quality contributed significantly ($p = .04$ and $p = .006$, respectively) to the prediction of accuracy scores on the copy trial. For the 30-min delay trial, neither spatial ability nor organizational quality were significant in a multivariate linear model adjusting for copy accuracy, although both were significant univariate predictors. These results suggest that higher levels of spatial visualization ability improve organizational strategy and copy accuracy on the ROCF, but do not improve recall of the figure once copy accuracy is accounted for. This supports recent findings

that recall decrements on the ROCF in older individuals are not due to poorer spatial organization.
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C. RONCADIN & J.B. RICH. Clustering and Switching on Verbal Fluency Tasks in Childhood and Adolescence.
Two components of verbal fluency performance have recently been identified in adults: clustering (i.e., generating words within subcategories) and switching (i.e., shifting between subcategories). These components have been associated with temporal and frontal lobe functioning, respectively. For example, older adults show declines in switching, but not clustering, which is believed to reflect age-related changes in frontal lobe functioning. At the other end of the lifespan, the frontal lobes mature much later than the temporal lobes. In fact, myelinization of the frontal lobes continues well into adolescence and early adulthood. We expected, therefore, that the clustering component of verbal fluency would plateau earlier than switching. We examined these components on phonemic and semantic fluency performance among 96 normally developing children and adolescents (8 children each from ages 6–17). On both phonemic (FAS) and semantic (Animals) word generation, age was strongly correlated with total correct words generated (phonemic: $r = .69$, $p < .001$; semantic: $r = .63$, $p < .001$), and with number of switches (phonemic: $r = .66$, $p < .001$; semantic: $r = .40$, $p < .001$). In contrast, mean cluster size was unrelated to age on both tasks, suggesting that developmental gains in clustering must occur during the preschool years. These results are consistent with findings among adult populations that switching depends on the integrity of the frontal system, whereas clustering appears to rely on more posterior regions of the brain.
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T.D. FUNG, H. CHERTKOW, T. PAUS, & C. WHATMOUGH. TMS of the Left Inferior Temporal Cortex Slows Picture Naming.
Functional neuroimaging studies have identified a number of brain regions involved in picture naming, including the left inferior temporal cortex (ITC). To investigate whether the ITC contribution is critical for picture naming, we used transcranial magnetic stimulation (TMS) to interfere with ITC activity during the performance of a naming task. First, we acquired functional magnetic resonance images in 6 volunteers performing a picture-naming task that identifies brain regions known to contribute to semantic processing. We contrasted activity during naming of harder (less familiar) pictures *versus* that of easier (more familiar) pictures. The left ITC was predominantly activated, centering at (−46, −55, −7) on Talairach coordinates with some individual variability. Using frameless stereotaxy, we then targeted this region individually with a brief train of repetitive TMS during picture naming. TMS significantly slowed picture-naming latency by an average of 93 ms when applied over the left ITC, but not the contralateral ITC or the left middle parietal lobe region. Thus, fMRI showed that the left inferior temporal cortex was normally activated when semantically processing pictures, and TMS could selectively interfere with picture-naming when applied to this brain region. We therefore demonstrated that the left ITC is critically important and necessary for picture naming in healthy individuals. The use of the fMRI/TMS combination is a powerful approach to study structure-function relationships in the brain.
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C. OUELLET, M.-T. LE NORMAND, & H. COHEN. Language Acquisition With Multichannel Cochlear Implant.
Normal language development is characterized by a progression of linguistic sequences evolving from: (1) discrimination of speech sounds, (2) phoneme segmentation and bending that gradually increase the number of known words, and (3) the combination of these words as the combinatorial rules of grammar are mastered. This is the first study to document the nature and time course of an atypic language acquisition process marked by neonatal auditory deprivation and subsequent language experience through electrical stimulation. Sixteen deaf French children were tested over a 24-month post-cochlear implantation period. Computerized analyses for morphosyntaxic assembly and lexical extent and diversity were derived from spontaneous speech in a 20-min standardized play session. Results show 3 distinct profiles when compared to normal evolution of syntactic abilities. Furthermore, the relationship between word combination mastering and lexical maturation is not as clear as the one found in normal language processing. Implanted subjects remain delayed in all production measures when compared to chronologically similar and even younger hearing children, but reached better scores than their counterparts when duration of auditory experience was considered. Heterogeneity in linguistic acquisition profiles are discussed in terms of etiology of deafness and duration of auditory deafferentation. Results emphasize the importance of longitudinal studies in documenting intersubject variability and intrasubject inconsistency throughout the experience with an implant. The study also shows the potential and limitations of functional brain plasticity.
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H.L. ROTH, A.L. HOLLINGSWORTH, A.M. CIMINO-KNIGHT, & S.E. NADEAU. Naming From Concepts: Evidence for Two Routes.
The Wernickel-Lichtheim model of language that was motivated by lesion studies of aphasia posits 3 central components of language: acoustic, articulatory, and semantic or conceptual. A parallel distributed processing (PDP) model of language was recently proposed that can be mapped onto the Wernicke-Lichtheim model and also features these 3 basic components. This PDP model predicts 2 routes for naming. In one route concepts are connected directly to articulatory word forms, in the other route concepts access sublexical phonological sequence information contained in the connectivity between acoustic and articulatory motor representations. This report describes a left-handed patient who has a chronic Broca's aphasia due to a left hemisphere infarct whose spontaneous language and naming to confrontation suggested that he might use a "whole word" route for naming. In spontaneous speech he had severe anomia and made semantic paraphasic errors, but not phonemic paraphasic errors. We conducted a naming study in which he was given a semantic cue, a phonologic cue, and no cue when naming 90 black and white line drawings. When given semantic cues his naming behavior did not change from baseline. When given phonological cues he modestly improved his naming accuracy, but generated profuse phonemic paraphasia, very different from baseline and his spontaneous speech. The results suggest that the patient normally engaged a whole word naming pathway, but when given phonological cues he engaged an alternative phonological naming pathway. The case provides preliminary support for the posited model which proposes 2 alternate routes from concepts to word production.
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C.E. WIERENGA, A.B. MOORE, B. CROSSON, L.M. MAHER, D. SOLTYSIK, K.K. PECK, K. GOPINATH, K.M. HEILMAN, L. J.G. ROTHI, D. KENDALL, & R.W. BRIGGS. Changes in Brain Activation with Treatment of Agrammatism: An fMRI Study.
Two agrammatic subjects, one with a left fronto-temporo-parietal infarct (subject 1) and the other with a left frontal infarct (subject 2) received treatment to improve their sentence production. To learn how treatment of agrammatism influences brain activation, both subjects underwent pre- and post-treatment fMRI of sentence generation. Both subjects received mapping treatment where sentence production was paired with a color and spatially coded mapping template focusing on thematic role positions of the major lexical items in the sentence. Both subjects demonstrated a positive treatment effect, with subject 2 showing greater generalization to

untreated items. During fMRI (2-spiral gradient echo acquisition), subjects silently generated sentences describing events depicted in line drawings. Deconvolution analysis was used to derive hemodynamic responses for sentence generation compared to a baseline state, passive viewing of nonsense objects. Subject 1 showed more robust activity post-TX than pre-TX in Broca's area and, to some degree, in the right anterior frontal lobe. Left ventral temporal activity was greater pre- than post-TX. Comparison of subject 2's pre-TX and post-TX images revealed a generally similar pattern of activity, though activity was more compact post-TX than pre-TX. These findings suggest subject 2's improvement in sentence generation involved learning to more efficiently use those areas activated prior to treatment.

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M.E. HAINES & L.M. SHEEHY. Crossed Wernicke's Aphasia: A Case Study.

Crossed aphasia (CA) is a phenomenon in which an individual sustains a lesion in the right hemisphere (typically nonlanguage dominant), but who exhibits an aphasic syndrome. The communicative-cognitive performance of an adult man with crossed Wernicke's aphasia following a cerebrovascular accident was longitudinally examined during rehabilitation. The patient was a 67-year-old, right-handed, monolinguistic man with no family history of left-handedness. Results of computed tomography localized the lesion to the right hemisphere only, involving the right middle cerebral artery. Initial language testing revealed moderate to severe Wernicke's aphasia. It was evident that the lesion had not solely affected language functions; the gentleman also evidenced visual perceptual deficits, a common sequela in right-side lesions. A 6-month follow-up evaluation indicated improvements in his language functioning, but he continued to exhibit moderate Wernicke's aphasia. The literature on CA raises several important questions. (1) Is CA a mirror image, that is, a complete reversal of the normal pattern (left hemisphere) for language function? (2) Does this atypical cerebral dominance suggest that other functions (i.e., attention, visual perception) are redistributed or spared? (3) What type of relationship exists between the language dominant hemisphere and the type of aphasia? (4) Does the interpretation of CA apply to the general issue of right hemisphere language function and recovery from aphasia in general (regardless of right/left lesion location)? The present case study attempted to address some of these questions.

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S. YANIV & J. AHARON-PERETZ. Spike Focus Presenting as a Posterior Parietal Heteromodal Cortex Disconnection.

A nine-year-old boy presented with abrupt onset of "forgetting how to read." Evaluation revealed a posterior left parietal heteromodal cortex disconnection syndrome associated with an epileptic spike focus in the same region. Detailed investigation revealed the following: (1) normal auditory and elementary visual and somatosensory functions, (2) normal for age attention, concentration, and memory functions, (3) impairment in reading letters which shared morphological similarities, but no difficulty in reading Arabic numerals; auditory letter-by-letter reading was normal, (4) severely impaired graphesthesia; however letters and objects could be identified by palpation, (5) spelling aloud was phonologically correct (but individual letter naming was impaired), (6) writing had the characteristics of lexical agraphia, (7) ideomotor apraxia was prominent including inability to recognize the motor act when it was presented by the examiner, (8) impaired constructional praxis. The full-blown syndrome persisted for one month and performance gradually improved over the following 9 months. Agraphesthesia persisted throughout the follow-up period. The neuropsychological impairment was associated with EEG spikes and sharp waves, which were either generalized or focal over the left posterior-parieto-temporal regions. The spike and sharp wave frequency gradually decreased with time from 49.8/min during the first month when the neuropsychological impairment was most evident to 22.3/min after 9 months when only impaired graphesthesia was still evident.

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M. HALEY & A. RAYMER. Aphasia and Limb Apraxia in Left-Handers with Right Hemisphere Damage.

Only 10% of the population is left-handed and an estimated 15% of those individuals have right hemisphere specialization for language. Therefore, it is rare to find left-handers with aphasia following right hemisphere damage. The patterns of impairment in these individuals are of considerable interest as some have proposed that handedness is related to hemispheric dominance for either language or praxis. We tested 3 left-handed individuals, as confirmed on a handedness questionnaire, who developed aphasia following right hemisphere strokes. We examined performance in 4 experimental language and praxis tasks using the Florida Action Recall Test (scenes which imply a tool and action, e.g., a log implies a hatchet and chopping), as well as tasks assessing right hemisphere abilities for prosody and spatial attention. None of the 3 demonstrated appreciable neglect. All 3 had mild impairments in comprehending and expressing emotional prosody. The 3 individuals presented varying forms of aphasia (anomic, Broca's, and Wernicke's) and limb apraxia (mild ideomotor, moderate ideomotor, and severe conceptual). Two also had significant oral-nonverbal apraxia. Subject 1 had greater impairment in gesture retrieval than in noun and verb retrieval. Subject 2 had greater impairment in noun comprehension and retrieval than verb and gesture retrieval. Subject 3 had severe impairment in all language and gesture tasks. These variations in language and praxis impairments, particularly in 2 of the left-handed subjects, suggests that neither language nor praxis alone determines handedness and that a complex set of factors are involved in establishing handedness in a given individual.

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A.M. CIMINO-KNIGHT, A.L. HOLLINGSWORTH, L.M. MAHER, A.M. RAYMER, A.L. FOUNDAS, K.M. HEILMAN, & L. J. GONZALEZ-ROTHI. Forms of Recovery in Ideomotor Apraxia: A Preliminary Investigation.

Ideomotor limb apraxia (IMA) is a disorder of skilled purposeful arm/hand movement that commonly results from left hemisphere damage. Two forms of IMA have been proposed. While this notion is controversial, it has been suggested that the proposed forms can be identified based on performance on 2 tasks, pantomime to verbal command (PVC) and gesture recognition (GR). If the praxis mechanisms required to perform these 2 praxis tasks are independent, and thus reflect measurement of different levels of the praxis system, one would predict that they might recover differentially. The purpose of this study, therefore, was to assess the performance of apraxic subjects on these 2 tasks during the early stages of recovery from acute stroke (CVA). Twelve subjects with left CVAs were tested within 6 weeks post onset (T1) and again between 3–6 months post onset (T2) on PVC and GR subtests of the Florida Apraxia Battery (Rothi et al., 1992). All patients demonstrated apraxia (i.e., score of $< 50\%$ on PVC). The assumption was that patients who were able to recognize gestures experienced a disconnection of relatively intact movement representations from mechanisms of action implementation, while poor gesture reception ability would imply degradation of the representation itself. We found that PVC at T1 was correlated with PVC at T2 but GR at T1 was not correlated with GR at T2. This dissociation between the evolution of PVC and GR performance during recovery is consistent with the notion that praxis production and praxis comprehension involve distinct processes which are controlled by separate neural subsystems.

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K. CHIPMAN & E. HAMPSON. Evidence for a Female Advantage in the Sequential Production of Learned Gestures.

The manual praxis system is a left-hemisphere motor programming system involved in the selection of hand and arm movements, especially

when several movements must be selected in sequence. Research suggests that, among apraxic patients, women may be less impaired than men on a well-known clinical measure of apraxia. Although preliminary evidence from neurologically intact individuals supports this possibility, the tasks used were not ideally suited for the assessment of manual praxis. To further investigate a possible female advantage in normal praxic function, we conducted an experiment using a motor task composed of movements more closely resembling those impaired in apraxia. Participants were taught to execute 9 novel hand and arm postures in response to computer-generated color cues. They then practiced the postures over 20 acquisition trials, after which the color cues were placed on a timer and presented in randomized sequences at progressively faster speeds. We compared 26 men and 25 women with respect to the maximum speed attained, and the frequency of "praxic" *versus* "nonpraxic" errors. All errors were scored by detailed videotape analysis. As predicted, women passed the task at significantly faster speeds than men, even though they were no faster at reacting to a color cue or at executing a single forelimb posture. Women also made significantly fewer perseverative and substitution errors than men, despite equal numbers of errors in other, nonpraxic categories. These findings are consistent with reports that the praxis system is more focally organized within the left hemisphere of women than of men.
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A. MÉNARD, M-T. LE NORMAND, & H. COHEN. Follow-Up Study of Language Development in a Child With Left Hemispherectomy.
A follow-up study of a left hemispherectomized boy (AB) was conducted to document linguistic evolution and maturation and to determine the extent to which the isolated right hemisphere (RH) allows development of language. Resection of the left hemisphere (LH) occurred at age 5 years 6 months, following intractable epilepsy. Tests of language comprehension (pointing, understanding of prepositions, understanding of narratives), production (naming, repetition, lexical diversity, grammatical production), and cognitive performance (visual spatial, cognitive semantic, praxic, memory) have been assessed at ages 6 years 11 months and 8 years. A longitudinal study with AB during the first year post surgery revealed limited spontaneous speech and markedly decreased and persisting deficits in both comprehension and production, as well as an inability to adequately complete any cognitive task. In the present study, observations showed marked progress in most aspects of language development, supporting the idea of RH ability to support multiple elements of linguistic processing. However, some components, such as syntactic abilities, remained limited and poorer than might be expected from mental age estimations. The observed persistent deficits argue for an early and preferential involvement of the LH for the development of specific aspects of linguistic performance. Furthermore, AB's pattern of linguistic evolution indirectly proposes that individual brain maturation rates and/or secondary consequences of the surgical resection may intervene with language recovery during many months following surgery and account for AB's slow to start linguistic progress.
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L. FREEDMAN, D. SELCHEN, & C. BASSEL. Thalamic Anomia: Case Report With CT and Serial Neurocognitive Findings.
A severe anomia developed in a 55-year-old, right-handed teacher following an ischemic infarction of the left thalamus. The acute brain CT revealed a large area of infarction affecting portions of the anterolateral, dorsomedial, and intramedullary nuclei, implicating predominant involvement of the tuberothalamic artery. Baseline examination performed 4 days post-infarction elicited a profound visual anomia (BNT = 6/60) accompanied by nonfluent, hesitant output. There were additional language abnormalities involving auditory comprehension and written expression, although these resolved over time. Functional memory was surprisingly intact, despite severe psychometric compromise in verbal learning ability. Serial neurocognitive testing performed at 4.5 and 15.5 months post-infarction documented significant interval improvements in visual naming, speech/generative fluency, verbal IQ/memory, and executive functions, although there remained a moderate anomia (BNT = 38/60) and subtle frontal dysfunction (e.g., rigid thinking, reduced flexibility, concrete reasoning, obsessive-compulsive proclivities) at final follow-up. Anomia is not an uncommon deficit following infarction of the anterior, dominant thalamus, and its anatomic/vascular basis and range of language and neurocognitive sequelae will be surveyed, discussed, and reviewed.
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M. KAMINSKY, Z. EVIATAR, & J. NORMAN. The Requirements of Hebrew Reading and Their Effects on Dyslexia.
Hebrew reading is based on morphological decomposition of the word into its root and pattern. It requires root awareness in the mental lexicon and early root extraction in the process of word identification (e.g., Frost, Forster, & Deutch, 1977). In this process, keeping the 3 root letters in their original order is essential for a successful lexical entry. Dyslexics are considered to have deficits in temporal and timing processing (Stein & Walsh, 1997), so it is hypothesized that they would exhibit difficulties in rapid recognition of the root and in maintaining letter-order. In this study, visual tasks of extracting trigrams that approximate the extraction of Hebrew roots were presented at 3 experimental levels: (1) *Basic*, with no requirement to sequential judgment, (2) *Nonlinguistic-sequential*, where order judgment is necessary, and (3) *Linguistic*, which is comprised of pseudo-roots in pseudo-words, and of real root extraction. The performance of dyslexic children was compared to 2 control groups: a group of age-matched normally reading children and a group of reading-matched younger children. Results show that in terms of reaction time, dyslexics were significantly slower than the age-matched controls, and behaved similarly to the young reading matched group on all of the levels. However, in terms of percentage errors, dyslexics were similar to both control groups, with one exception: they made more errors than the age-matched controls just on the linguistic level.
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Paper Session 6/1:30–3:15 p.m.

NON-ALZHEIMER'S DISEASE

T. LINEWEAVER, D. SALMON, M. BONDI, & J. COREY-BLOOM. Mental Rotation Abilities in Alzheimer's Disease and Huntington's Disease Patients.
Although visuospatial processing deficits occur in both Alzheimer's disease (AD) and Huntington's disease (HD), little is known about the specific mechanisms that underlies these impairments. Mental rotation is a complex visuospatial task that requires spatial and temporal manipulation of objects, as well as judgments of right-left orientation. Mental rotation tasks might, therefore, be particularly effective for identifying differences in the processing deficits engendered by distinct dementing disorders. Reaction times (RT) and error rates of 18 HD patients, 20 younger normal controls, 18 AD patients, and 20 older normal controls on a computerized mental rotation task were compared in a series of repeated measures analyses of variance. Relative to their respective control groups, both HD and AD patients demonstrated deficits in right-left orientation (i.e., a higher incidence of errors in a nonrotated condition). HD patients also showed decreased speed of rotation, but normal spatial manipulation of objects (i.e., significant Group × Degree of Rotation interaction for RT but not errors). In contrast, AD patients demonstrated normal speed of rotation (on correct trials), but impaired spatial manipulation (i.e., significant Group × Degree of Rotation interaction for errors but not RT). This double-

dissociation suggests that the temporal and spatial manipulation components involved in mental rotation are mediated by distinct brain regions. The cognitive slowing (i.e., bradyphrenia) exhibited by HD patients may be mediated by damage to the basal ganglia, whereas the spatial manipulation deficit of patients with AD may be mediated by cortical pathology in the parietal lobe and/or middle temporal gyrus.

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J.M. HAMILTON, D.P. SALMON, D. GALASKO, & L.A. HANSEN. Distinct Memory Deficits in Dementia with Lewy Bodies and Alzheimer's Disease.

Dementia with Lewy Bodies (DLB) is a clinicopathological disorder characterized by subcortical and diffusely distributed neocortical Lewy bodies accompanied by varying degrees of Alzheimer's disease (AD) pathology. Recent studies have begun to differentiate the clinical features of the dementia syndromes of DLB and AD, but relatively little is known about possible differences in the memory deficits that occur in the 2 disorders. To address this issue, we compared 23 autopsy-confirmed DLB and 23 age-, education-, and MMSE-matched autopsy-confirmed AD patients on the California Verbal Learning Test (CVLT) and the Wechsler Memory Scale–Revised (WMS–R) Logical Memory Test (LMT). Paired *t* tests showed that the groups were comparable on the CVLT learning (trials 1–5: DLB = 17.57 ± 6.5 *vs.* AD = 17.96 ± 9.3; $t = .16$, $p = .87$) and long delay free recall (DLB = 1.57 ± 1.9 *vs.* AD = 1.04 ± 1.6; $t = -1.2$, $p = .23$) measures and the immediate recall measure from the LMT (DLB = 9.26 ± 5.8 *vs.* AD = 9.09 ± 6.0; $t = -.10$, $p = .92$). In contrast, the DLB patients performed significantly better than the AD patients on the CVLT recognition discriminability measure (DLB = .70 ± .13 *vs.* AD = .59 ± .12; $t = -2.79$, $p = .01$), the LMT delayed recall measure (DLB = 5.00 ± 4.9 *vs.* AD = 2.09 ± 3.5; $t = -2.38$, $p = .03$) and LMT savings score (DLB = .46 ± .4 *vs.* AD = .19 ± .3; $t = -2.62$, $p = .02$). These results indicate that while both DLB and AD patients exhibit significant memory impairment, the ability to consolidate information may be less severely impaired in DLB patients than in patients with AD. The severity of the consolidation deficit may be related to the degree of concomitant AD pathology.

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C. LEVERONI, J. ZIMBLEMAN, S. DURGERIAN, J. PAULSEN, N. REYNOLDS, & S.M. RAO. Patterns of Neural Activation Associated with Time Perception in Presymptomatic Huntington's Disease: An fMRI Study.

We investigated time perception in 14 presymptomatic individuals with CAG expansion of the HD gene and 7 age and education matched controls. Disease onset age was estimated using a regression equation. HD subjects were subdivided into 2 groups based upon estimated years to motor symptom onset (7 "close" subjects < 10 years; 7 "far" subjects > 10 years). Subjects underwent fMRI while performing a temporal (T) discrimination task during which they indicated whether a comparison tone-pair was longer or shorter than a standard tone pair (1200 ms ISI), and a pitch (P) discrimination task during which they indicated if a fourth tone was higher or lower in pitch than 3 standard tones. Both conditions were compared to a sensorimotor control condition. "Close" HD subjects performed significantly worse than controls on the T condition; a trend toward worse performance was also observed in the "far" HD subjects. Accordingly, a significant group difference in the T condition was observed in the brain activation maps: "close" HD subjects displayed significantly less activation in subcortical structures (basal ganglia, thalamus) than controls. The subcortical activation patterns of the "far" HD subjects were intermediate to the other 2 groups. In contrast, "far" HD subjects displayed greater activation in the anterior cingulate and SMA than "close" HD subjects and controls. No significant group differences were observed on the P condition. We speculate that medial prefrontal mechanisms compensate for reduced subcortical participation during temporal processing in early presymptomatic HD; however, these compensatory mechanisms become compromised with disease advancement.

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R. GARDINER, G. GLOSSER, B. COSLETT, & M. GROSSMAN. Semantic Memory Impairment Does Not Affect Reading in a Case of Semantic Dementia.

Semantic dementia patients have been reported consistently to demonstrate a surface dyslexia characterized by (1) a significant impairment for reading words with exceptional spelling-to-sound correspondence and normal reading of words with regular spelling, and (2) the production of "regularization errors." It has been suggested that this reading disturbance is due to a deterioration of semantic representations that disrupts processing within the orthographic and/or phonological lexicons. The effect of a severe and progressive semantic impairment on phonological and orthographic processing was evaluated in a patient with probable semantic dementia, who presented with severe anomia and impaired single-word comprehension, but with relative sparing of other components of nonverbal problem-solving abilities and episodic memory. On a test of semantic processing (Pyramids and Palm Trees; PPTT), accuracy for both word and picture judgments was markedly impaired (69% and 71%, respectively). Despite the semantic memory impairment, 100% of words used in the PPTT were read aloud perfectly, including all 16 exception words. Reading was also unimpaired on another test comparing directly reading for high and low frequency words with regular and exceptional spelling. These findings indicate that semantic impairment does not necessarily lead to orthographic or phonological disruption and are most consistent with the notion that the language processing system is comprised of functionally independent processing components.

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J.M. MURPHY, J.H. KRAMER, H. J. ROSEN, & B.L. MILLER. Anatomic Substrates of Executive Functions and Semantic Memory in FTLD.

Frontotemporal lobar dementia (FTLD) is a neurodegenerative disorder affecting the frontal and anterior temporal lobes. The present study evaluates the relationship between frontal and anterior temporal lobe volumes and performance on language and executive tasks in 17 FTLD patients (mean MMSE = 23) and normal controls. Each subject received a 15-item version of the Boston Naming Test (BNT), verbal fluency (# of D words in 60 seconds), and nonverbal fluency (DKEFS design fluency) test. MRI volumes were calculated in the axial plane for the frontal lobe and in the coronal plane for the temporal lobe. All brain region sizes were adjusted for total intracranial volume. The association between specific brain regions and neuropsychological performance was assessed with 2 multiple regression analyses, with MMSE placed in the first step to control for general cognition. In the first regression analysis, frontal volumes were forced into the model to control for generalized atrophy, with anterior temporal volumes placed in the last step. The inclusion of the anterior temporal volumes explained an additional 21.9% of the variance ($p < .01$) of BNT performance, indicating a strong relationship between naming and anterior temporal lobes. In a second regression, after forcing in anterior temporal volumes to control for generalized atrophy, frontal volume explained 19.6% of the variance ($p < .05$) of the verbal fluency task and 29.1% of the variance ($p < .05$) of the design fluency task. Results support brain-behavior models linking frontal structures with executive functions and anterior temporal lobes with semantic memory.

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R. SWARTZ, D. CALLEN, & S. BLACK. A Model of Vascular Cognitive Impairment: Integrating Imaging, Pathology, and Anatomy.
Neuropathological studies have identified the major limbic and cortical brain areas involved in Alzheimer's disease (AD) (Braak and Braak, 1995). These structures have also been identified as central to memory processing in animal and human studies. However, the contribution of strategically located or more diffuse cerebrovascular disease (CVD) has not been adequately integrated into neuroanatomical models of cognitive impairment. We explored the effects of atrophy and CVD on cognition in a large, neuropsychologically characterized memory clinic sample. Strokes of limbic system structures, affected early in the neuropathology of AD, figured prominently in "pure" vascular cognitive impairment (VCI): 3 people presented with isolated anterior-medial thalamic strokes, 4 with medial temporal, 1 with only isocortical association area strokes, and 19 with multiple key areas involved. These strokes were correlated with diverse cognitive deficits, including memory-language, attention, and executive dysfunctions. Vascular disease may also contribute to cognitive impairment indirectly; in our sample, hyperintensities disrupted acetylcholinergic projections in 0/34 NC, 25/109 pure AD and 28/43 VCI. Based on these *in vivo* studies, we propose an integrated model of dementia, which extends beyond existing neuroanatomical models focused on medial temporal involvement, to include multiple limbic and cortical regions, as well as cholinergic and cortical-subcortical white matter projections. In this model, brain lesions can be viewed as affecting primary (sufficient to cause dementia) or secondary (aggravating or unmasking) structures or pathways. This conceptual framework provides a basis for future brain-behavior studies of cognitive impairment in AD, CVD, and other dementias.
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L. FREEDMAN, D. SELCHEN, B. TEMPLE, C. BASSEL, L. DEXTER, & S. BANERJEE. Frontal Lobe Degeneration With and Without Motor Neuron Disease: Similarities and Differences.
Frontal lobe degeneration (FLD) is a clinical heterogeneous but well-defined neuropathological entity comprised of 3 distinct subtypes that include FLD with Pick-type pathology (i.e., Pick inclusions, ballooned neurons), FLD without Pick changes (e.g., neuronal loss, spongiform change, and gliosis), and FLD with motor neuron disease (MND). We reviewed and compared the neuroimaging and cognitive findings in a sample of patients diagnosed with FLD with ($n = 5$) and without ($n = 14$) MND to determine the similarities and differences between these 2 FLD entities. Patients diagnosed with a nonfluent progressive aphasia without prominent changes in social and personality function were excluded from the analysis. While the comparative analysis did not reveal intergroup differences across a variety of cognitive measures, including those of frontal lobe function, the sample with FLD without MND had a greater proportion of CT-verified frontal lobe atrophy than those with FLD and MND (85.7% *vs.* 20%, respectively, z (statistic for proportions) = 2.8, $p < .05$). Conversely, the FLD/MND group had a significantly higher rate of aphasia (40%) at initial presentation than the FLD sample (0%; $z = 2.56$, $p < .05$). SPECT was equally sensitive (100%) in confirming predominant frontal lobe involvement in both groups. The potential diagnostic, clinical, and neuropathological relevance of these intergroup differences with respect to the classification of FLD subtypes will be discussed.
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Paper Session 7/1:30–3:15 p.m.

CHILD DEVELOPMENT

J.F. KULAS & L.D. STANFORD. Comparison of Standard and Age-Equivalent Scores on the BSID-II and VABS-SF.
Assessment of the development level of young children has taken on an increasingly important role in medical and psychological assessment. Two of the most widely used measures to assess a child's developmental level are the Bayley Scales of Infant Development–Second Edition (BSID–II) and the Vineland Adaptive Behavior Scales–Survey Form (VABS–SF). The 2 instruments can be administered together so as to provide converging information about a child's level of cognitive and motoric development. However, the scales are often administered separately and used as equivalent estimates of development. The comparability of the 2 measures is not clear. Participants for the current study were 34 (20 male, 14 female) outpatient-referred children for neurodevelopmental evaluation as part of a comprehensive assessment for epilepsy surgery candidacy. Participants were administered the BSID–II and the VABS–SF in the standardized fashion in the course of a comprehensive neurodevelopmental evaluation. A significant discrepancy between the standard scores of the BSID–II and the VABS–SF was obtained for both mental and motor skills. This discrepancy was not demonstrated when age-equivalents were used. These results replicate previous work completed by Raggio, Massingale, & Bass (1994) who found similar results with the original version of the BSID. It is recommended that clinicians use age-equivalent scores when comparing these 2 measures. Underlying psychometric issues related to the construction of the VABS–SF are discussed as likely contributors to the discrepancies.
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Y.C. HO & A. CHAN. Music Training Improves Verbal But Not Visual Memory: 1-Year Longitudinal Study.
Experience affects the development of cognitive processing. Previous studies reported that adults (Chan et al., 1998) and children (Ho et al., 2000) with music training demonstrated better verbal but not visual memory than their counterparts without music training. This specific improvement of memory was proposed to be related to the variation of cortical structure between musicians and nonmusicians in which the former group demonstrated a relatively larger left planum temporale. To examine the causation effect of the results reported by these cross-sectional studies, the present study followed 3 groups of children for one year. The first group ($n = 17$) did not have music training at the baseline, and had received one year training at the second testing (NMT–MT). The second group ($n = 9$) were receiving music training at the baseline, but had terminated the lessons for at least 9 months prior to the second testing (MT–NMT). The third group ($n = 24$) were children having music training at the baseline and retest levels (MT–MT). Their verbal memory was assessed with the Hong Kong List Learning Test and their visual memory was examined with the Brief Visuospatial Memory Test–Revised. The NMT–MT (mean = 15.63%) group demonstrated similar improvement in their verbal memory as the MT–MT (mean = 10.17%) group, whereas the MT–NMT (mean = −3.94%) group did not show improvement in their verbal memory. The performances of the 3 groups in the visual memory test were not significantly different. These results support our previous finding that music training improves verbal but not visual memory.
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A. BOUMA, H. VAN DER VEER, K. SEUME, & H. AKKERBOOM. Dyslexia in Black, South African Children: A Sequential or a Phonological Processing Deficit?
The present study was designed to investigate the relationship between word recognition deficits and the nature of cognitive processing strategies in black, South African disabled readers. The Kaufman Assessment Battery for Children (K–ABC) was employed to measure different types of information processing strategies. It was expected deficient sequential processing strategies would be a primary problem in disabled readers. The nature of word recognition tasks was investigated by asking the children to read aloud different types of words (regular words, irregular words, nonwords). Also the phonological awareness skills were measured in these children by using tasks relying on phonological analysis of words (pho-

neme segmentation, phoneme deletion, and phoneme position). The results revealed that dyslexics performed significantly lower than controls on both the Simultaneous and the Sequential Processing Scales of the K–ABC. Compared to controls, dyslexics also showed impaired performance on phonological awareness tasks. We observed that phonological awareness deficits were highly related to word recognition difficulties in dyslexics, but not in controls. Although phonological awareness deficits in disabled readers were significantly related to sequential processing strategies, there was no evidence for the view that sequential processing deficits were related to the reading difficulties observed in these children. These findings suggest that poor phonological awareness, rather than deficient sequential information processing strategies, contribute to the dyslexics' word recognition deficits. It will be argued that the results observed in the black, South African children are quite comparable to those seen in other cultures.

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B. WILLIAMS & K. KERNS. Validation of the Brock Adaptive Functioning Questionnaire for Children.

This paper describes The Brock Adaptive Functioning Questionnaire for Children (BAFQ–C), a revised version of an executive function measure that was developed for adult traumatic brain injury populations. The BAFQ–C yields 12 subscales: Planning, Initiation, Flexibility, Lack of Content, Attention, Memory, Arousal Level, Emotionality, Impulsivity, Aggressiveness, Social Monitoring, and Empathy. Validation of the BAFQ–C used a 3-fold strategy: (1) The factor structure of the 12 scales was examined and compared to that of the BAFQ; (2) Children's scores on the BAFQ–C were compared to those on a published measure of executive function in children [the Behavior Rating Inventory of Executive Function (BRIEF)]; and (3) BAFQ–C scale scores from a control sample were compared with those from a sample of children with symptoms consistent with a diagnosis of ADHD. Data from 127 children including 86 control and 41 ADHD subjects were used in the analysis. Consistent with that found in the BAFQ, factor analysis yielded 2 factors that were interpreted according to an orbitofrontal/dorsolateral function distinction. Strong, statistically significant correlations (ranging between .76 and .84) were found between subscales of the BRIEF and subscales of the BAFQ–C purporting to measure similar constructs. Finally, control participants scored statistically significantly higher than ADHD participants on Planning, Initiation, Memory, Social Monitoring, and Empathy. The data presented here provide evidence for the validity of this instrument. It is expected that the BAFQ–C will be useful in both clinical and research settings. The relationship between BAFQ–C and BRIEF scales with cognitive measures of executive function will also be discussed.

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B. J. FORREST. Math Skills, Executive Function, and Social Abilities in Children with NVLD.

This study examined the criteria employed to identify children with nonverbal learning disabilities (NVLD). NVLD definitions have relied on deficits in visual-spatial-organizational, tactile-perceptual, psychomotor, and nonverbal problem-solving skills. These deficits coexist with strengths in rote verbal learning, phoneme-grapheme matching, verbal output, and verbal classification. The deficits have been hypothesized to lead to a configuration of psychosocial and academic problems including difficulties with mathematics, increased rates of internalized psychopathology, and social deficits. This study compared performance of 3 groups of children: NVLD, verbal learning disabilities (VLD), and controls. The results show that the criteria used to identify NVLD may not differentiate these children. Children with NVLD can show good math abilities, especially in relation to their robust verbal skills. Some children with NVLD exhibit social deficits; however, these difficulties could be linked to difficulties with executive functions. Finally, their visual-perceptual deficits may arise primarily from difficulty locating objects in space. As part of a reconceptualization of NVLD it may be helpful for diagnostic and treatment purposes to reserve the term for children whose visual-spatial deficits are primary and severe enough to affect academic performance. Given the integral nature of social relations in children's lives, a separate category (e.g., social processing disorder) could be created for children whose social skills deficits are primary and impair their social interactions. The results of this study also support the delineation of a brain system for social processing that involves both the efficient perception of people and the ability to profit from environmental feedback.

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K. CULHANE-SHELBURNE, S. ROGERS, & S. HEPBURN. Comparison of Cognitive Profiles in Young Children With Autism and Other Developmental Disabilities.

The profile of cognitive strengths and weaknesses in children with autism has been of great interest, however it is unclear whether these cognitive profiles are unique to autism. Cognitive profiles were compared for 6 groups of developmentally disabled children: 22 children with autism (IA), 14 with fragile X syndrome (FX), 10 with fragile X syndrome and autism (FXA), 6 with idiopathic developmental delays (IDD), 9 with Down syndrome (DS), and 21 typically developing children (TYP). The chronological ages of the 5 DD groups were not significantly different and ranged from 21 to 48 months. The TYP group was matched on mental age with the DD groups, with chronological ages ranging from 12 to 25 months. Developmental quotients were calculated from the 5 domains scores of the Mullens Scales of Early Learning: fine and gross motor skills, receptive and expressive language, and nonverbal reasoning. There was more variability in the domain scores of the IA group than others, and the FXA group was the lowest functioning of the groups across cognitive domains. The nonverbal reasoning scores of the autism group were significantly higher than their other domain scores, excepting gross motor. Vineland communication and socialization skills were lowest for subjects with autism, while the IDD and DS group did not differ from the TYP group on these measures. These preliminary results suggest that cognitive profiles of children with autism differ from those of children with other disabilities and that children with FX who also have autism incur more significant cognitive deficits.

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W.D.S. KILLGORE & D.A. YURGELUN-TODD. Developmental Changes in the Lateralized Activation of the Prefrontal Cortex and Amygdala During the Processing of Facial Affect.

Many cognitive functions become more lateralized in the neocortex as children mature through adolescence into adulthood. Although certain affective processing systems appear to be lateralized as well, the developmental trajectory of functional lateralization of emotional processing across the adolescent maturational period has not been investigated. Presently, we used fMRI to study the extent of lateralized activation within the amygdala and dorsolateral prefrontal cortex across 3 age groups, which included 7 healthy preadolescent children (age: 9–12), 12 adolescents (age: 13–17), and 10 adults (age: 20–29). Subjects underwent BOLD fMRI while viewing 30-sec blocks depicting photographs of fearful faces that alternated with a resting control condition. Multivariate analysis of variance revealed that the asymmetry of activation of the amygdala and prefrontal cortex differed across the 3 age groups ($p < .05$), suggesting developmental differences in the functional lateralization of these 2 regions during affect perception. Activation within the amygdala was left-lateralized in childhood, right-lateralized during adolescence, and again left-lateralized by adulthood ($p < .05$). Although prefrontal lateralization did not differ significantly across age groups ($p = .18$), when activation within prefrontal and amygdala regions were compared ipsilaterally and contralaterally, adolescence was uniquely associated with a pattern of increased right prefrontal and reduced left amygdala activation ($p = .02$).

Given prior research evidence that right hemisphere activation is often associated with negative affect and left amygdala activation with threat appraisal, we speculate that this pattern of activation may partially account for the increased affective variability and risk taking behavior often seen during adolescence.
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Paper Session 8/1:30–3:15 p.m.

EPILEPSY

K. ARFANAKIS, B.P. HERMANN, V.M. HAUGHTON, M.E. MEYERAND, & M. SEIDENBERG. Diffusion Tensor MRI Reveals White Matter Abnormalities in Temporal Lobe Epilepsy.
The aim of this investigation was to compare diffusion tensor MRI results (DT–MRI) in temporal lobe epilepsy patients *versus* controls, and examine the relationship between age of onset and DT–MRI measures. A total of 13 patients with focal temporal lobe epilepsy and 11 age-matched healthy controls were investigated with DT–MRI. Diffusion anisotropy (DA) which, due to the presence of myelin and neuronal membranes, characterizes the amount of restriction in the diffusion of protons along given directions relative to others. DA was estimated for each voxel in the brain of every subject. DA values from regions of interest (ROI) located in the arcuate fasciculus, anterior and posterior corpus callosum, anterior and posterior internal capsule, were compared between the epilepsy patients and the controls. Reduced DA was detected in all ROIs of the patient population compared to the same values in the controls. The differences were more significant in the corpus callosum and arcuate fasciculus than in the internal capsule. A significant positive correlation between DA and age of onset was also detected in the corpus callosum and arcuate fasciculus. This study suggests that abnormalities in focal temporal lobe epilepsy patients are not restricted to the temporal lobes but extend to other regions including white matter tracks. In addition, since low DA translates to low restriction in diffusion perpendicular to the axons, the positive correlation between DA and age of onset suggests that early onset epilepsy might have an adverse effect on the development of myelin and neuronal membranes.
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W. BARR, M. RAGHAVAN, P. NELSON, & O. DEVINSKY. Prediction of False-Positive Recognition Memory Errors During Wada Testing.
The purpose of this study was to determine which set of clinical and neuropsychological variables may be useful for predicting the occurrence of intrusion errors during Wada testing. Fifty-six patients with diagnoses of partial epilepsy confirmed through VEEG monitoring (29 left frontotemporal; 27 right frontotemporal) completed presurgical neuropsychological evaluations and Wada testing. Memory for 8 objects and 4 line-drawings was evaluated through yes/no recognition testing. These data were compared with those obtained from the CVLT. Predictor variables included demographic factors, seizure variables, Wada test variables, and CVLT memory indices. Nineteen patients (34%) were found to have 2 or more FP errors during the Wada testing. These patients exhibited a higher number of recall intrusion errors and FP errors on CVLT recognition testing. The results of a linear regression model found FP errors from the CVLT to be the single most significant predictor of FP errors during the Wada ($F = 9.38$, $p < .01$). The correlation between the 2 types of FP errors was significant (Pearson $r = .384$, $p < .01$). Patients with less than 2 FP errors on the CVLT were at reduced risk for having a high number of FP errors on the IAP (Odds Ratio = 1.85, 95% CI = 1.21, 2.83). The occurrence of FP errors appears to be more related to an enduring "response-bias" rather than to any other clinical factor. The findings from this study indicate that recognition memory scores from neuropsychological testing provide a valid prediction of FP errors during Wada testing.
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M. DULAY, J. FARGO, & B.K. SCHEFFT. Impact of Symptoms of Depression and Anxiety on Verbal Memory in Epilepsy and Pseudoseizures.
Recent research indicates that the effects of interictal depression are associated with diminished neuropsychological performance in patients with temporal lobe epilepsy. The present study assessed the impact of symptoms of depression and anxiety on verbal memory and learning performance in adults with medically intractable epilepsy and pseudoseizures. Fifty-five patients diagnosed with complex partial seizures of unilateral temporal lobe origin (34 left, 21 right), 27 patients with seizures of generalized or multifocal origin, and 44 patients with pseudoseizures, all confirmed with extended inpatient video/EEG monitoring techniques, were assessed. Tasks included 2 MMPI–2/MMPI scales (Depression and Psychasthenia) and 3 auditory subtests of the Wechsler Memory Scale–III [Logical Memory, Verbal Paired Associates (VPA), Word Lists]. After data were orthogonally coded based on hypothesis-driven contrasts and group membership (seizure focus/pseudoseizures, elevated symptoms of depression/nondepressed), they were subjected to sequential multiple regression analyses. Covariates were included in follow-up analyses to assess the impact of seizure frequency, duration of illness, attention (ACDQ), and naming (e.g., Boston Naming Test). Results indicated significant group differences. For example, patients with left temporal lobe epilepsy performed more poorly on VPA I and II as a function of elevated symptoms of depression [$F(1,49) = 3.39$, $p < .05$]. For all auditory subtests, there was no significant main effect for group membership after controlling for naming ability. Similar results were found for elevated symptoms of anxiety. Results are consonant with previous research and demonstrate the significant impact of naming ability on the relationship between mood and performance on verbal memory and learning tasks.
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R. MARTIN, T. KRETZMER, S. SAWRIE, C. PALMER, R. KNOWLTON, E. FAUGHT, & R. KUZNIEICKY. Base Rates of Memory Outcome Following Anterior Temporal Lobectomy: Relationships With Severity of Hippocampal Pathology.
This study investigated base rate distributions of memory change following anterior temporal lobectomy (ATL) across patients who had pathology-verified mild, moderate, or severe hippocampal neuronal loss. Unilateral temporal lobe epilepsy patients (72 left, 48 right) were administered measures of verbal and visual memory before and after surgery. The degree of neuronal loss and reactive gliosis of the hippocampus was assessed via a 3-tiered rating system establishing degree of hippocampal pathology (HP). Only patients with unilateral hippocampal sclerosis by MRI were included in the study. Laterality, but not severity of HP, was statistically associated with preoperative verbal memory performance. Preoperative visual memory performance was not related to laterality or severity of HP. Postoperatively, 50% of all left ATL patients demonstrated verbal memory decline, while 25% of right ATL patients showed decline on at least one verbal memory measure. The proportion of patients demonstrating decline in visual memory was similar between left and right ATL groups. The proportion of left ATL patients with severe HP demonstrating memory decline was similar to left ATL patients with mild HP. The majority of patients undergoing right ATL, regardless of the extent of HP, displayed no postoperative memory change. Seizure continuation following ATL was strongly associated with negative memory outcome in patients with severe HP. Our results revealed a substantial amount of individual heterogeneity of memory outcome across ATL patients with varying degrees of HP. The

present study found that the presence of severe HP did not attenuate the probability of experiencing memory decline following ATL.
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M.P.H. HENDRIKS, M. VAN GRUIJTHUIJSEN, A.P. ALDENKAMP, & H. VAN DER VLUGT. Memory and Language Functions in Patients with Right or Left Mesiotemporal or (Fronto)temporal Seizures.
We performed a multicenter study on memory functioning in 252 epilepsy patients who subjectively complain about their memory. One hundred ninety-two patients had seizures originating from the left ($N = 116$) or right ($N = 76$) temporal lobes. All patients were given a full battery of neuropsychological tests including general intellectual functioning, language functions, attention and concentration, visual constructive abilities, and obviously memory functions. The purpose of the study was to examine memory impairments in both groups and see if these are related to language deficits. With MANCOVA and verbal intelligence as a covariance, the left temporal lobe group, as compared to the right temporal lobe patients, scored significantly lower on all measures of verbal memory. Furthermore, we found no significant differences between those groups on language tests. However, when controlling for both IQ and language, significant differences between both temporal groups disappear. Within the left temporal lobe group, patients were subdivided on the basis of their mesiotemporal or (fronto)temporal abnormalities. Within the mesiotemporal lobe group only a highly significant negative correlation was found between naming and an index for delayed recall ($p = .022$). Furthermore, naming correlated with verbal tasks of recognition memory ($p = .044$). In the patients with left (fronto)temporal abnormalities, all correlations between measurements of verbal memory and most of the language functions were significant. It may be concluded that in the latter group, memory deficits are related to underlying language deficits, whereas in the mesiotemporal lobe group memory deficits are not.
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S.M. FRESHWATER, E.B. FENNELL, R.L. GILMORE, S. EISENSCHENK, & S.N. ROPER. Depression, Hippocampal Volumetrics, and Laterality of Lesion in Temporal Lobe Epilepsy.
Prior studies conducted with depressed patients have suggested a relationship between hippocampal volume and depressive symptomatology. Whether this relationship exists with temporal lobe epilepsy (TLE) patients has not previously been studied. The following study specifically investigated TLE patients with and without MMPI–2 indicators of depression, comparing hippocampal volumetrics (left *vs.* right), and laterality of epileptic pathology. MRI was used to measure hippocampi volumes in 16 TLE patients with complete valid MMPI–2 protocols. Patients were classified as Depressed ($n = 5$; D-scale $T = 75$) and Non-Depressed ($n = 11$; D-scale $T = 56$) based upon a MMPI–2 clinical cut-off elevation of $\geq T65$ on the Depression Scale. For final analysis, patients were reclassified by hemisphere of epileptic focus. There was a significant difference between the Depressed *versus* Non-Depressed groups in left hippocampal volume ($p = .005$), but not for right hippocampal volume ($p > .10$). There was a significant Pearson correlation ($r = .647$) between left hippocampal volume and the Depressed group's MMPI–2 *T*-score elevation, but not for right hippocampal volume ($r = -.088$). For the Non-Depressed group, neither right ($r = -.252$) or left ($r = -.133$) hippocampal volumetric studies were significantly correlated with depression. Paired sample *t* tests revealed nonsignificant volumetric differences (left *vs.* right) for the Depressed ($p = .25$) and Non-Depressed groups ($p = .165$). In the final analysis, the mean Depression score for the left TLE focus group ($T = 58$) was below that of the right TLE focus group ($T = 65$) whose scores reached clinically significant levels.
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K. GETZ, B. HERMANN, B. BELL, C. DOW, J. JONES, A. WOODARD, P. RUTECKI, R. SHETH, & M. SEIDENBERG. Psychosocial Correlates of Negative Symptoms in Temporal Lobe Epilepsy.
Negative symptoms, psychiatric behaviors that reflect a reduction in normal behavior, have historically been identified in individuals with schizophrenia, but have more recently been observed in patients with a range of neurological and neuropsychiatric disorders, including bipolar disorder, Alzheimer's disease, and strokes. Most recently, negative symptoms have been identified in a subset of patients with temporal lobe epilepsy (TLE), a neurological disorder that often presents with psychiatric features. In schizophrenia, negative symptoms have been found to be associated with higher rehospitalization rates, unemployment, and marital status; however, the relationship between negative symptoms and psychosocial factors in TLE is not yet known. Therefore, the purpose of this study was to examine the relationship between negative symptoms and psychosocial factors in TLE by comparing TLE patients with and without negative symptoms on a broad range of psychosocial variables. A sample of 84 patients determined to have TLE were identified as having either none or more than none negative symptoms. These 2 groups were statistically compared in terms of psychosocial variables including current rates of marital and employment status, receipt of government financial assistance, quality of life, family medical/psychiatric history, and clinical variables. As a result of these analyses, the TLE group with negative symptoms was found to present with higher rates of social, economic, and functional difficulties relative to the TLE control group. These findings are commensurate with those of similar studies conducted within the schizophrenia population. Treatment targeting negative symptoms may translate into less need for government assistance within the TLE population.
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Symposium 5/1:30–3:15 p.m.

NEUROPSYCHOLOGY AND THE DIAGNOSIS OF MILD COGNITIVE IMPAIRMENT

Organizer and Chair: Glenn Smith

G. SMITH, O. ALMKVIST, M. ALBERT, H. CHERTKOW, & R. PETERSEN. Neuropsychology and the Diagnosis of Mild Cognitive Impairment.
Symposium General Abstract: Mild cognitive impairment (MCI) is a classification that has been promoted to describe the boundary between age-related cognitive changes and dementia. This diagnosis appears to identify persons at significantly elevated risk to progress to a full dementia syndrome. However, the rate and certainty of progression has been debated. The role of neuropsychological testing in establishing the diagnosis of MCI has also been controversial. Some have advocated strict cognitive cutoffs to operationalize the diagnosis, while others have proposed less rigorous clinical criteria. This symposium presents various views on the role of neuropsychology in the diagnosis of MCI and how various approaches may influence MCI outcomes. An international panel of MCI investigators reviews their experiences regarding cognitive evaluation and MCI diagnosis and offers opinions on the role of neuropsychological testing in this diagnosis. This panel includes Glenn Smith from Mayo Clinic, Rochester, Minnesota, USA, Ove Almkvist from the Karolinska Institute, Stockholm, Sweden, Marilyn Albert from Massachusetts General Hospital, Boston, Massachusetts, USA, and Howard Chertkow, from Lady Davis Institute-Jewish General Hospital, Montreal, Quebec, Canada. Ronald Petersen, proponent of one of the widely accepted criteria for MCI serves as discussant.
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G. SMITH, R. IVNIK, & J. CERHAN. MCI as a Clinical *versus* Psychometric Diagnosis.
A dilemma in operationalizing the diagnosis of mild cognitive impairment (MCI) is whether to use strict psychometric cut-offs (e.g., scores in one or more cognitive domains at least 1.5 *SD* below age-appropriate means) *versus* using clinical judgment informed by test results. We applied 1.5 *SD* cutoffs to 200 clinically-defined MCI patients and 943 normals' scores on memory (percent retention on AVLT, WMS–R Logical Memory, and Visual Reproduction) and nonmemory (Perceptual Organization, Boston Naming, COWAT, Category Fluency, and Trails B) measures. Of the MCI patients, 23% had no impairments, 47% had impaired performance only in memory, 8.5% had only impaired nonmemory performance, and 21% had memory plus nonmemory impairments. Among the normals, 79% had no impairments, 10% memory only, 8% nonmemory impairment, and 3% memory plus nonmemory impairment. Thus, strict cutoffs would identify somewhat different MCI and normal groups than were defined clinically. As expected from the normal distribution, a percentage of normal individuals will fall below −1.5 *SD* on any measure. Further, mild cognitive dysfunction can be identified clinically in many people before cognitive scores fall below −1.5 *SD*s. We contend that clinical diagnosis will be more sensitive and specific with regard to MCI. Longitudinal data revealed that persons with clinically-defined MCI were more likely to convert to Alzheimer's than those defined by cut-offs (Likelihood Ratios 5.2 *vs.* 2.1). The primary role for neuropsychology in the diagnosis of MCI appears to be in establishing clinically the presence of circumscribed cognitive impairment and the absence of global cognitive decline, not in establishing strict psychometric cutoffs.
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O. ALMKVIST. MCI Diagnosis: Lessons From Familial Alzheimer's Disease.
In order to discuss the concept of MCI, the border zones between normal aging (NA) *versus* mild cognitive impairment (MCI) as well as MCI *versus* Alzheimer's disease (AD) should be considered. The empirical data presented here are based on repeated assessments of subjects carrying mutated genes that cause future development of familial AD (fAD). The transition from cognition typical for NA across MCI to AD is described using a comprehensive set of neuropsychological tests. Subjects from the same families but without AD-mutated genes served as controls. Various conceptual models of MCI are tested using the neuropsychological data from fAD families. Finally, the generalizability of the pattern of neuropsychological test results coming from subjects with fAD is compared with results from longitudinal clinical and epidemiological studies of sporadic AD.
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M. ALBERT. The Role of Neuropsychology in Examining the Prodromal Phase of AD.
The neuropsychological performance of 300 subjects who have been followed over time will be reviewed. Approximately three-quarters of these individuals had mild memory difficulty and one-quarter were controls at baseline. Neuropsychological data will be presented based on dividing these subjects in several ways in order to compare results across several research centers. The subjects will be divided into 3 types of groups for purposes of comparison. (1) One grouping will be based on how the subjects memory difficulty evolved over time, i.e., subjects with mild memory difficulties who progressed to meet criteria for probable AD within 5 years will be compared to those who did not meet these criteria within 5 years *versus* individuals who were controls over all periods of evaluation. (2) A second grouping will be based on the degree of functional difficulty among the subjects [using the Clinical Dementia Rating (CDR) scale measure known as the Sum of Boxes]; subjects with high levels of functional difficulty in daily life will be compared to subjects with low levels of functional difficulty in daily life *versus* controls. (3) A third grouping will be similar to the second, except that the individuals with memory difficulty will be subdivided into 3 groups, as has been done by some investigators. The goal of this presentation will be to facilitate comparisons of neuropsychological findings across sites in a research area that has increasing clinical importance for patients.
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H. CHERTKOW, S. MURTHA, H. BERGMAN, L. BABINS, N. KELNER, & V. WHITEHEAD. How Useful Are Neuropsychological Measures for Prognostication in MCI?
There are few reliable predictors for the likelihood of developing dementia over longitudinal follow-up in mild cognitive impairment (MCI) subjects. At the same time, the increase in predictive power attributable to neuropsychological testing of such patients remains to be determined. We followed 90 elderly MCI subjects over a mean follow-up period of 38 months. All received detailed clinical, neuropsychological, cognitive reaction time, and imaging (MRI) assessments at entry into the study. At the end of follow-up period, 51 subjects had deteriorated to dementia (progressors group), and 39 had not (nonprogressors group). Evaluated retrospectively, a simple bedside clinical algorithm would have been able to stratify 40% of such individuals into low and high risk of progression. On logistic regression, 2 neuropsychology measures (logical memory 1 and logical memory 2 scores), and 2 cognitive measures—mean reaction time for carrying out a lexical (word/nonword) decision, and trigram recall of the Brown Peterson task (a measure of working memory)—were significant predictors of membership in the progressors *versus* the nonprogressors group. These measures correctly predicted classification of 85% of MCI individuals. It was found that an algorithm including the above measures along with age at onset of memory loss, initial MMSE score, and an MRI hippocampal atrophy ratio measure best predicted risk of progression to dementia. Neuropsychological and cognitive measures are useful in prognostication, but are most accurate when supplemented by clinical, demographic, and imaging variables.
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Symposium 6/1:30–3:15 p.m.

NONVERBAL LEARNING DISABILITIES: SCREENING, NEUROPSYCHOLOGICAL ASSESSMENT, ELECTROPHYSIOLOGICAL EVIDENCE, AND INTERVENTION

Organizer and Chair: L.M. J. de Sonneville

L.M. J. DE SONNEVILLE. Nonverbal Learning Disabilities: Screening, Neuropsychological Assessment, Electrophysiological Evidence, and Intervention.
The developmental neuropsychological profile of specific assets and deficits, now known as the nonverbal learning disabilities (NLD) syndrome, has evolved into a major area of research since the 1970s. Early on, WISC verbal-performance discrepancy studies dominated the focus of interest, followed by neuropsychological profile and subtyping studies. Typically, the ability to adapt to or recover from deficits over time, as observed in brain-damaged children, is seriously compromised in children with NLD. They even seem to "grow into the deficits" (Rourke, 1989) which suggests implications for intervention and treatment strategies. The major issues comprising this symposium on NLD are screening, neuropsychological assessment, cerebral organization, and intervention. Serlier-van den Bergh

will describe the development and construction of the Dutch NLD scale as a screening instrument for use by parents and teachers, which is also fascinating from a cross-cultural perspective. De Sonneville will describe central processing deficiencies associated with NLD [i.e., psychomotor speed, attentional flexibility, visuospatial memory, and social information processing (faces, emotions)], in an attempt to substantiate the concept of NLD as a continuum. Verschoor will report the effects of pre- and dysmaturity on psychomotor development in a longitudinal study of children at 2 and 6 years of age, with special reference to the persistence of unfavorable NLD-like outcome over time. Njiokiktjien will report new evidence on variations in cortical organization associated with NLD *versus* VLD in an EEG coherence study. Finally, Glass will describe the results of a multisensory intervention strategy, used in a pilot study in children with LD, ADHD, and NLD.

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A.M.H.L. SERLIER-VAN DEN BERGH. The Dutch Nonverbal Learning Disabilities (NLD) Scale.

The development and construction of the Dutch Nonverbal Learning Disabilities (D–NLD) scale for children aged 6–12 years was accomplished in 3 subsequent studies that were focused on the construction, refinement, and final psychometric properties of the scale. The D–NLD scale is derived from the theoretical framework of NLD and inspired on the NLD scale of Byron Rourke (1993). It was assumed that an observational Likert rating scale could measure the behavioral characteristics of NLD. The first study ($N = 120$) was conducted to evaluate the first version of the Dutch scale. After item comparison, the original 40 items were extended with another set of 40 items. The second study ($N = 1936$) was undertaken to construct the final Dutch version. A series of item-response analyses within a regular and special education population reduced the scale to 34 items. In the third study ($N = 1709$) the final D–NLD scale was administered to parents and teachers of 80 normal and 80 children "at risk for NLD" from a suburban regular Dutch school population. The NLD total score refers to 3 possibilities reflecting NLD as a continuum: a low probability of NLD, possible NLD, and high probability of NLD. Results suggested that the Dutch NLD scale is an appropriate instrument for screening purposes. The scale offers clinical implications for further comprehensive neuropsychological evaluation.

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L.M. J. DE SONNEVILLE & A.M.H.L. SERLIER-VAN DEN BERGH. Information Processing Characteristics of Children with NLD.

This study focuses on information processing characteristics in 160 children from a suburban regular Dutch school population (Serlier-van den Bergh, first paper), who were assigned to 3 groups: "definite NLD" ($n = 59$, 9.4 ± 1.4 years), "possible NLD" ($n = 54$, 9.6 ± 1.3 years) and "no NLD" ($n = 47$, 10.1 ± 1.2 years). The Amsterdam Neuropsychological Tasks program was administered to evaluate skills in the psychomotor domain (simple reaction time, unimanual tapping, bimanual synchronous, and alternated tapping), memory for visuospatial temporal sequences, executive function (visual/auditory attentional flexibility), and social information processing (face recognition, identification of facial emotions). The tapping task did not discriminate between groups. Simple reaction time was (somewhat) slower in the "definite NLD" group compared to the other two groups. Visuospatial memory was impaired in the "definite NLD" group. Executive function deficits, as indicated by a disproportionate deterioration in performance when attentional flexibility was required, were also clearly present in this group. Face recognition and emotion identification were impaired in the "definite NLD" group, with lowest scores for the identification of "anger." Depending on task, differences were reflected in response speed, stability of response speed, and/or accuracy. Strikingly, for the majority of the tasks, we observed an intermediate position of the "possibly NLD" group as regards task performance level. This outcome suggests the presence of a neuropsychological continuum of NLD rather than a NLD dichotomy. The findings will further be interpreted with reference to left/right hemisphere specialization, the outcome of recent studies of executive function, and face/emotion processing in clinical groups (LD, CD, ADHD, risk for internalizing psychopathology–dysthymia).

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C.A. VERSCHOOR, C. NJIOKIKTJIEN, B. HOPKINS, & L.M. J. DE SONNEVILLE. Neuropsychological Outcome After a Preterm Birth: Indications of the NLD Syndrome.

The main aim of this study was to evaluate the effects of pre- and dysmaturity on psychomotor development. To this end, 29 healthy, low risk, appropriate, and small for gestational age preterm children were compared to 21 full-term controls on the results of a broad neurological, motor, and cognitive assessment in a longitudinal follow-up at the age of 2 and 6 years. At the age of 2 years, the results show indications of either a mild general psychomotor retardation or a specific profile with nonoptimal neuromotor and nonverbal visuospatial skills, but an average level of speech and language development, in more than half of the preterm children. At 6 years, most of these preterm children showed the latter profile, now with additional attentional and behavioral problems. The outcome is thought to reflect characteristics of the syndrome of nonverbal learning disabilities and of the sequelae of major brain injury related to prematurity. As to the underlying factors, these findings suggest covert perinatal insult hampering right hemisphere functions to a greater extent than those of the left hemisphere.

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C. NJIOKIKTJIEN. Nonverbal Learning Disability: A Developmental Right Hemisphere Deficit Syndrome?

Since the 1980s, neurologists have recognized a right hemisphere (RH) deficit syndrome with left-sided motor and sensory signs as well as cognitive and behavioral deficits. At the same time Rourke et al. described nonverbal learning disability (NLD). In fact, both the RH deficit syndrome and NLD converge. Rourke ascribes NLD to a dysfunctional RH and points to a typical ontogenetic course in NLD. As babies and toddlers they acquire milestones somewhat late and they do not explore much. At later school age, mathematics, general concept acquisition, and social contact become worse, and performance IQ can go down 20–50 points. In 30 children with NLD we found 6 children with such a marked regression of function. MRI scans, however, were without abnormalities. There might be a neural regression, respectively, either a programmed neuronal disconnection or synaptic loss by "non-use." White matter disorder (Rourke) in NLD should be understood as abnormal connections. Whether the developmental dysfunctions in NLD are associated with interhemispheric and/or intrahemispheric variations in cortical organization has been studied through EEG coherence (Coh), reflecting functional interregional coupling. We could confirm the hypothesis of RH hypoconnection in NLD by demonstrating that children with NLD have lower intrahemispheric Cohs in the RH in the gamma band (28–50 Hz), whereas a control clinical group with verbal learning disability (VLD) (without nonverbal comorbidity) does not show this. Gamma band interhemispheric coherences (ICohs) over F7/F8 and T3/T4 were lower than in VLD children, and gamma band ICohs were higher in NLD compared to VLD over O1O2.

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K. GLASS, M. CORLETT, & M. SEMRUD-CLIKEMAN. An Intervention Program for the Development of Social Competence.

The social competence intervention program (SCIP) is a multisensory intervention that includes a metacognitive component. The underlying

assumption of the intervention is that some children suffer from perceptual and interpretive deficits as well as poor social skills. In this pilot program, we adapted exercises used in theater classes to remediate these underlying deficits in children with learning disabilities and attention deficit disorders. In addressing the processes involved in social interaction, the exercises were structured to move from perception of emotions (input), to interpretation (or integration), and then to response (or output). We were interested in examining whether the children were able to integrate the various perceived stimuli to form a cohesive and accurate interpretation. The constant novelty, increasing complexity, and cyclic nature of activities were expected to aid in the generalization of skills. Exercises to reduce inhibition, and to develop trust and group cohesion were included in each session. Anecdotal evidence from the pilot study suggests that participating children began to develop some self-awareness of their feelings and behaviors and the subsequent impact on social interaction, self-awareness, self-control, and gradations of emotional response. This program offers a promising beginning to addressing the needs of those children with serious difficulties in social competence. This presentation will provide an overview of our use of this program with children with learning disabilities (LD), attention-deficit hyperactivity disorder (ADHD), and nonverbal learning disabilities (NLD). Preliminary data will be presented as to the use of the program, as well as qualitative data as to parent evaluation of the program.

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Paper Session 9/3:30–5:15 p.m.

LANGUAGE

M. CATO, B. CROSSON, D. GÖKÇAY, D. SOLTYSIK, C. WIERENGA, K. GOPINATH, H. BELANGER, N. HIMES, R. BAUER, I. FISCHLER, L. J. GONZALEZ-ROTHI, & R. BRIGGS. Emotional Connotation as Semantic Attribute: A Whole Brain fMRI Study of Emotional Valence and Sex Effects on Word Generation.

The contribution of semantic attributes to the organization of semantic information in the brain is examined using whole brain fMRI. Emotional connotation is conceptualized as a semantic attribute that cuts across semantic categories and was examined in a word generation paradigm to determine if unique patterns of activation occur as a function of this attribute. Twenty-six strongly right-handed, healthy participants (13 male, 13 female) engaged in a language task that alternated between silent word generation to categories with positive, negative, or neutral emotional connotations and a baseline task of silent neutral word repetition. Common areas of activity for the 3-word generation tasks relative to neutral word repetition included Broca's area and left medial frontal cortex (presupplementary motor area). Activation uniquely associated with word generation to categories with emotional connotation relative to neutral word generation included bilateral cortex near the frontal poles and in the retrosplenial area bilaterally. Activity associated with emotional connotation was lateralized to the left hemisphere, presumably due to the language demands inherent in the word generation task. Examination of valence (positive or negative) effects revealed that in the less active right hemisphere, relatively more activity was found for positive than negative categories. The sex (males *vs.* females) of participants was not found to further influence the pattern of brain activity associated with emotional connotation. This study provides strong support for the importance of item attributes in semantic processing.

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A. CHAN, D. YEUNG, Y. CHAN, W. HE, M. CHEUNG, J. LAM, & M. CHUNG. Different Neurocognitive Semantic Process for Alphabetic and Logographic Languages.

There is no universal agreement concerning whether alphabetic and logographic languages are processed by one or two different neurocognitive networks. While some studies suggested that bilinguals process different languages differentially only at the phonetic and syntax level but not at the semantic level, other studies demonstrated contradictory results. To investigate this issue, we studied a group of 6 right-handed, Chinese-English bilinguals (mean age: 27; average education: 17 years), who learned both languages before age 10, with functional magnetic imaging technique (fMRI) using Chinese and English verbal fluency tests. Experiments were performed on a 1.5 T MRI system and 60 images per slice location were acquired during 3 task-rest cycles. In the Chinese verbal fluency task, the subjects generated silently the examples when seeing a categorical name. A similar procedure was done for the English condition, except that the subjects generated the examples in English. The results showed that half of the subjects demonstrated activation of bilateral frontal cortex during the Chinese verbal fluency task and left frontal activation during the English one. One subject showed right frontal activation during the English task, but left frontal lobe activation during the Chinese task. While previous fMRI studies on English monolinguals reported that left Broca's area and left superior and middle frontal gyrus are involved in the verbal fluency test, only one subject demonstrated this pattern of activation on both Chinese and English tasks. This result supports the notion that different neurocognitive networks are used to mediate the semantic processing of Chinese and English.

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J. KULAS, C. DREES, G. J. CHELUNE, I. NAJM, E. WYLLIE, W. BINGAMAN, & H. LÜDERS. The Effect of Temporal Lobectomy on Naming: A Multifactorial Approach.

Previous studies investigating the effects of temporal lobectomy (TL) on visual confrontation naming have generally focused on the role of individual rather than on the interaction between temporal structures. As surgical procedures used in TL do not allow for the removal of gyri in isolation, these studies may not have accounted for the integrated nature of these structures. The present study investigated the effects of dominant hemisphere TL on visual confrontation naming ability using a multifactorial approach. One hundred sixty-three patients underwent TL for medically intractable temporal lobe epilepsy. The post-operative MRI scans were examined to determine the linear extent of resection of the superior, middle, and inferior temporal gyri, the fusiform gyrus, parahippocampal gyrus, hippocampus, and amygdala. The extent of resection was then compared with each patient's change in naming ability using the Standardized Regression Based norms for the Boston Naming Test. Stepwise multiple regression revealed a significant relationship for the interaction between the fusiform gyrus and the hippocampus ($R = .280$; $p < .001$) for dominant hemisphere resections. No single gyrus better predicted the change observed for naming ability. Patients undergoing a nondominant hemisphere TL did not evidence a significant change in naming ability following surgery. The results indicate the importance of basilar structures in visual confrontation naming ability. More importantly, the results of this study suggest that multifactorial approaches to investigation of localization of function will lead to better prediction of cognitive outcome following a TL.

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A. PAPANICOLAOU, P. SIMOS, J. BREIER, E. CASTILLO, & R. DAVIS. Language Mapping with Magnetoencephalography (MEG) Yields Results Comparable to the Wada Test.

Accurate and reliable identification of language-specific cortex is a critical part of the presurgical assessment of patients with disorders such as temporal lobe epilepsy. Language-specific cortex has been traditionally identified using 2 invasive techniques: the Wada test and cortical stimulation mapping. During the past 3 years, in a series of studies involving over 200 individuals, we have demonstrated the feasibility of mapping receptive language-specific cortex in individual normal subjects and patients

using the noninvasive functional brain imaging method of MEG. The reliability of such maps has been tested through repeated measurements of the same individuals over time, and the validity of the maps has been verified through comparisons with the results of direct cortical stimulation mapping. We report here on the results of an on-going study ($n = 73$ patients, both adults and children) in which we assess the concordance of MEG results with those from the Wada test in assessing hemispheric dominance for language. Our findings indicate that the agreement between MEG and the Wada procedure is very high: laterality judgments agreed 93% of the time (45/48 judgments agreed for LH dominance, 5/6 judgments agreed for RH dominance, and 18/19 judgments agreed for bilateral language representation). The high degree of concordance between the 2 methods indicates that it may be possible in the near future to substitute the invasive Wada procedure with the completely noninvasive method of MEG. Accordingly, the purpose of this presentation is to describe the method and discuss the implications of its use with clinical populations.
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N.S. FOLDI, N. HELM-ESTABROOKS, & D.G. NICKEL. Vulnerability to Perseveration: A Unitary or Dissociated Mechanism?
This study investigated whether perseveration occurs selectively in specific domains (i.e., linguistic–nonlinguistic), or across domains as a result of a pervasive neuropathological mechanism that may be affected by age. *Subjects:* Three clinical groups (LCVA + aphasia, $N = 10$; RCVA, $N = 6$; Alzheimer's disease, $N = 10$), and 3 nonclinical control groups (YngNC, $N = 17$; MidNC, $N = 16$; OldNC, $N = 16$). *Procedures:* Two timed generative production measures (animal names and designs) of the Cognitive Linguistic Quick Test (CLQT, Helm-Estabrooks, 2001) were analyzed. A Perseveration-Index [P-Index = (Total responses − Perseverations)/Total responses] calculated the negative effect of perseveration on subjects' generative skills. *Results:* First, a mixed ANOVA [Group (5) × Task (2)] compared the 3 clinical and 2 age-matched groups (MidNC and OldNC) using P-Index as the dependent variable. All groups perseverated more on design than animal generation [Task, $F(1,53) = 38.159$, $p < .0001$]. Group effect was significant [$F(4,53) = 3.025$, $p = .025$], due to AD-MidNC group differences (Tukey = .1074, $p < .05$). Each group displayed similar P-Index differences for the 2 tasks (Group × Task interaction, $F(4,53) = .171$, ns). Second, a mixed ANOVA on the 3 normal age groups showed P-Index differences for both tasks [Task, $F(1,46) = 59.39$, $p < .001$], with YngNC perseverating less than either older group [Age, $F(2,46) = 8.637$, $p < .001$]. P-Index worsened on design generation with increased age [Task × Age interaction, $F(2,46) = 5.15$, $p < .01$. Tukey, $p < .05$]. *Conclusions:* Findings showed all groups produced similar perseveration patterns on both generation tasks, suggesting a pervasive, nonlateralized, neuropathological mechanism for perseveration. Worse perseveration ratios for design generation occurred for all groups, even LCVA + aphasia. One explanation for this is that designs remain present, engendering pull-to-stimulus perseveration associated with subcortical-frontal systems particularly vulnerable to normal aging and AD.
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A. BOLLICH, C. LEONARD, E.B. FENNELL, T. KNAUS, D. COREY, & A. FOUNDAS. Atypical Posterior Perisylvian Structures in Children with Specific Language Impairment.
Specific language impairment (SLI) refers to developmental language disorders in the absence of gross neurologic or sensory deficits. It is familial and male predominant, suggesting the influence of genetic factors with sex-modified expression. Results of previous MRI studies suggest the presence of anatomic anomalies associated with SLI, although results have been inconsistent. The goal of this study was to compare gray-matter volumes of discretely measured posterior perisylvian language areas in children with SLI and normal language development (NLD). Regions of interest (ROIs), including Heschl's gyrus-HG, planum temporale-PT, posterior ascending ramus of the Sylvian fissure-PAR, and posterior superior temporal gyrus-pSTG, were measured on volumetric MRIs in 17 SLI (10 males; 10 right-handers) and 18 NLD (10 males; 12 right-handers) subjects matched for nonverbal IQ, sex, and handedness. All ROIs were calculated as a percentage of total brain volume to control for differences in brain size. MANOVAs suggested a significant leftward asymmetry of HG ($p = .001$) and PT ($p = .001$), with a rightward asymmetry of PAR ($p = .013$). For HG, a Diagnosis × Hemisphere × Handedness interaction was significant ($p = .019$), suggesting a leftward asymmetry of HG in right-handed ($p = .019$), but not left-handed controls. The opposite pattern was found for SLI subjects: left-handers showed a leftward asymmetry ($p = .016$), while right-handers did not. The results of this study strongly implicate the role of primary auditory cortex in the development of SLI, as well as the influence of sex and handedness in cortical development.
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M. GREENWALD & J. SHELTON. Ordinal and Phonological Influences on Impaired Word Recognition.
Visual, ordinal, and phonological influences in dyslexia remain poorly understood and highly controversial. Acquired dyslexia provides opportunities for isolating subcomponents of visual word recognition. For example, "visual" errors (soldier: "solid") may arise from disruption to visual attention, ordinal encoding, phonological recoding, or lexical orthography. Efforts to differentiate between these possibilities have been limited. We examined positional effects in impaired word recognition using materials specifically designed to examine prelexical ordinal and phonological information. Four left hemisphere stroke patients with moderate-severe aphasia who were English speaking, right-handed males completed oral reading, phonological recoding, speeded matching, lexical decision, parsing, and visual attention tasks. All patients performed normally on visual attention tasks. In oral reading, patients made many visual and visual-phonological errors (up to 80% errors). Overall, a leftward positional bias emerged in the reading errors. However, one patient demonstrated a rightward positional bias (particularly striking in the absence of a left visual neglect). Ordinal encoding was tested using rapid presentation and masking: word matching (deciding if 2 words were identical) and nonword matching (deciding if a probe letter appeared in a string of letters). Position was systematically varied. In both tasks, all patients showed strong leftward positional biases. Phonological recoding was moderate to poor in all patients (e.g., nonword reading < 32%). These results suggest positional biases in reading can be dissociated from visual-attentional deficits, and activation of ordinal information favors first letter position. Phonological recoding may be insufficient to activate ordinal information normally, resulting in increased leftward positional biases.
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Paper Session 10/3:30–5:15 p.m.

HEAD INJURY/REHABILITATION

Y. RASSOVSKY, P. SATZ, M. ALFANO, K. ZAUCHA, & C. CAETANO. Emotional and Neuropsychological Mediators of Functional Outcome in TBI.
It has been repeatedly shown in the literature that moderate-to-severe traumatic brain injury (TBI) is associated with emotional and cognitive impairment. Several studies have also found TBI severity to be predictive of impairment in social and occupational functioning. However, the factors responsible for mediating this functional impairment are less clearly understood. In the present study, structural equation modeling technique was used to evaluate the relative contribution of mood and neuropsychological status to functional outcome in 87 patients with moderate-to-severe TBI.

Employing a longitudinal design, we found that neuropsychological parameters, but not emotional status (i.e., depression), were significant mediators of the relationship between TBI severity and functional outcome at 12 months post-injury. These findings are consistent with hypotheses suggesting that while psychological factors might be important mediators of post-TBI adaptive functioning in the milder forms of head injury, it is the neurocognitive compromise that plays a more prominent role in mediating functional outcome in the more severe forms of head injury.
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M. PACHALSKA & B.D. MacQUEEN. The Reorganization of Autobiographical Memory in Patients With Traumatic Brain Injury.
Clinicians report that many traumatic brain injury (TBI) patients present with "paraschizophrenic" symptoms consisting in the confusion of events from the past and the present, and in blurring of the boundary between reality, fantasy, and dream, which disorganizes autobiographical memory. In the process of cognitive neurorehabilitation, mechanisms develop that regulate and adapt autobiographical memory, facilitating daily functioning. The purpose of this paper is to characterize and evaluate these mechanisms in the social reintegration of TBI patients. The research involved 29 TBI patients (comatose $>$ 2 months, post-traumatic amnesia $>$ 3 months), under treatment at the authors' rehabilitation centers. The instruments used to measure autobiographical memory included observation, structured interview, and standard neuropsychological batteries. The patients were examined 4 times during rehabilitation, which lasted 8–12 weeks. All the patients were found to have serious disorganization of autobiographical memory, producing in successive examinations a mosaic of differing images of self and reality. The patients were unable to arrange the fragments of their own biographies into a sensible whole; they demonstrated memory gaps regarding the biographies of significant others and facts from the past, though the clinical picture was not fully consistent with retrograde amnesia *per se*. The paper will describe the regulatory and adaptive mechanisms used by the patients. A model will be presented to explain the formation of an unstable, improvised autobiographical frame to impose a precarious provisional order on the mutual relation of persons and events actually residing in long-term and short-term memories, but improperly organized by the meta-memory.
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C. BOAKE, S.R. McCAULEY, H.S. LEVIN, S.A. BROWN, & H.S. GOODMAN. Diagnosis of Post-Concussional Disorder in Brain Injury and Extra-Cranial Trauma.
Objective: To compare the diagnosis of postconcussional disorder (PCD), as defined by the Diagnostic and Statistical Manual–IV (DSM–IV), between traumatic brain injury (TBI) and extra-cranial trauma. *Sample:* 150 unselected patients with mild-moderate TBI and 88 with trauma not involving the brain were recruited at a level-1 trauma center. *Design:* Inception cohort study. *Outcome Measures:* A structured interview of post-concussional symptoms was administered at 3 months after injury. The DSM–IV diagnosis of PCD was modified by waiving Criterion A (history of TBI) for extra-cranial trauma patients. *Results:* 25% of TBI patients met the full PCD diagnosis and 13% of extra-cranial trauma patients met all diagnostic criteria except Criterion A. TBI and extra-cranial trauma patients did not differ in frequency of meeting Criterion B (evidence of cognitive deficit) or Criterion E (impaired social functioning). Criterion C (post-concussional symptoms) was met more often by TBI (53%) than by extra-cranial trauma patients (38%). TBI patients reported higher frequencies of headache, vertigo-dizziness, irritability, and mood change. Among patients meeting the modified PCD diagnosis, only headache was reported more frequently by TBI patients. *Conclusions:* The higher frequency of post-concussional symptoms after TBI and their incidence after extra-cranial trauma suggest that post-concussional symptoms can result from multiple causes and are not specific to TBI. Headache may be reported more frequently after TBI. DSM–IV does not provide a diagnosis for non-TBI patients who meet other PCD criteria.
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T. ATCHISON, C. CONTANT, T. ROEBUCK, A. SANDER, M. STRUCHEN, T. NOVACK, J. SCHRAA, M. SHERER, & W. HIGH. Relationship Between Neuropsychological Performance and Productivity at 1 Year Post-TBI: Accounting for Injury Severity and Demographic Variables.
Functional outcome after traumatic brain injury (TBI) is determined by many factors: injury severity, demographic characteristics, neuropsychological function, and preinjury history are among the variables to consider. Understanding the relationship between predictive factors and long-term outcome is useful in informing treatment and rehabilitation decisions. The current study attempts to understand how these factors are related to productivity at 1-year post injury. Participants were 805 persons with TBI enrolled in the Model Systems Research and Demonstration Project, a prospective, multicenter longitudinal study on outcome following TBI. The research protocol includes a follow-up at 1 year after injury to assess outcome and cognitive function. Ability to complete a neuropsychological test may be as important in predicting outcome as actual test scores. In order to model this missing data, test scores from neuropsychological tests were dummy coded into 4 groups. The first group was defined as all subjects who had a missing test score. The remaining 3 groups were formed by dividing the test scores as evenly as possible into a top, middle, and bottom third performance group. Demographic, injury severity, and neuropsychological variables were entered into a backward logistic regression with a modified CIQ Productivity Scale as the outcome measure; 467 subjects had sufficient data to complete the analysis. The final solution was assessed for stability with a resampling procedure and included days to follow commands, age, preinjury productivity status, GOAT, Logical Memory II, and Trail Making B. These findings indicate that current neuropsychological performance is related to productivity beyond injury severity and demographics.
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D. DAWSON, B. LEVINE, M. SCHWARTZ, & D. STUSS. Psychological Moderators of Real-World Outcomes Following Traumatic Brain Injury.
The purpose of this study was to determine whether specific psychological factors and social support were associated with psychosocial distress, return to productivity (paid employment and/or school), and overall quality of life following traumatic brain injury (TBI). Participants in this study were recruited consecutively at time of admission. Four years post-TBI, 47 of 88 eligible persons (53%) returned for follow-up interviews. Participants in follow-up interviews were more severely injured than nonparticipants but did not differ on demographic factors. Depression, perceived control, and coping style were significantly associated with one or more of the 3 outcomes ($p \leq .001$). Persons with higher depression scores, lower levels of perceived control, and who were more apt to use escape-avoidance coping techniques reported more psychosocial distress, were less likely to return to work, and had a lower level of quality of life. Higher amounts of instrumental social support were significantly associated with lower psychosocial distress scores and with a higher quality of life ($p \leq .003$). Further, in planned hierarchical regressions, these factors accounted for significant amounts of variance over and above that explained by standard determinants of outcome (GCS scores and measures of post-traumatic confusion and amnesia). These results provide the impetus for further investigation of these factors as determinants of outcome and as important variables to be considered in rehabilitation interventions.
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S.A. YABLON, R. NAKASE THOMPSON, M. SHERER, P. TRZEPACZ, & T. NICK. Empirical Determination of the Domains of Cognitive and Behavioral Disturbance After TBI.

Various conceptualizations regarding altered consciousness following traumatic brain injury (TBI) exist. Impairment in memory and orientation has been described as post-traumatic amnesia (PTA) and is typically quantified by measures such as Galveston Orientation and Amnesia Test (GOAT). Further, Corrigan and Mysiw (1988) reported psychomotor agitation measured by the Agitated Behavior Scale (ABS) correlated significantly with impaired cognitive functioning following traumatic brain injury. Stuss and colleagues (1999) described altered consciousness following TBI as a confusional state with impairments in attention and memory consistent with DSM–IV description of delirium. Few studies have examined the relationship between delirium, amnesia, orientation, and agitation in a TBI sample. This study attempted to describe the factors underlying altered consciousness after TBI using measures of PTA, agitation, and delirium. Sixty-five consecutive TBI Model System patients rated a IV or above with the Ranchos Los Amigos Cognitive Scale during inpatient rehabilitation were observed prospectively each week of their hospitalization resulting in 261 complete weekly observations (*M* age 36.7, 78.5% male). All participants received scores on the Delirium Rating Scale (DeIRS), ABS, and GOAT. The ABS, GOAT, and items from the DeIRS were factor analyzed using all observations and revealed 3 significant factors (Fluctuating Symptoms, Psychotic Symptoms, and Persistent Cognitive Status) that accounted for 65% of the variance observed and was similar to factors when using only initial, independent ratings. The present findings contribute to conceptualizing specific domains of altered consciousness following TBI. Results suggest measures of PTA and agitation may not capture the full spectrum of cognitive and behavioral disturbance seen after TBI.

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R. NAKASE THOMPSON, M. SHERER, S.A. YABLON, R. KENNEDY, & T. NICK. Persistent Delirium and Outcome Following TBI.

Debate exists regarding the conceptualization of altered consciousness following traumatic brain injury (TBI). Stuss and colleagues (1999) described altered consciousness following TBI as a confusional state which is consistent with the DSM–IV classification of delirium. However, no study has investigated the relationship between delirium and outcome following TBI. The purpose of this study was to evaluate delirium status and its relationship to disability outcome at discharge from inpatient rehabilitation. Sixty-five consecutive TBI Model System patients rated a IV or above with the Ranchos Los Amigos Cognitive Scale during inpatient rehabilitation were prospectively evaluated (mean age 36.7; 78.5% male). All participants received admission and discharge scores on Functional Independence Measure subscales (CogFIM, MotFIM) and Disability Rating Scale (DISRS). Weekly evaluations to determine DSM–IV Delirium Diagnosis Criteria (DDC) were conducted. Forty-five individuals met DDC (D+) on initial ratings of which 31 resolved during rehabilitation hospitalization. Fourteen individuals were discharged in D+ and did not differ on indices of injury severity from individuals whose delirium resolved during acute care or rehabilitation hospitalization. Using analysis of covariance and controlling for severity of injury and admission ratings, individuals who were D+ at rehabilitation discharge generally had higher levels of disability on the DISRS, CogFIM, and MotFIM ($p < .05$) when compared to both individuals resolved during rehabilitation and acute hospitalization. This study demonstrates that delirium is prevalent among neuro-rehabilitation admissions and is associated with increased disability. Exploration of interventions to address symptoms of delirium may improve outcomes for individuals with persistent delirium following TBI.

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Paper Session 11/3:30–5:15 p.m.

GENDER AND LATERALITY

L. FRAKEY & R. BAUER. Gender Differences in Hippocampally Lesioned Subjects on a Spatial Memory Task.

It has been proposed that differences in spatial ability observed in males and females might be the result of evolutionary demands that would promote increased spatial ability and allocentric cognitive mapping abilities in males (hunter-gatherer theory). Past research has implicated the hippocampus as being a likely source for the construction and storage of cognitive maps. Structural, histological, and fMRI analyses of the hippocampus have found gender differences. Our study employed the Virtual Arena, a test of allocentric place learning. A computer analogue of the Morris water maze (MWM), this program presents a first-person view of a simulated environment that mimics the conditions of the MWM. Subjects use a joystick to navigate to a hidden target using distal cues. We used this program to assess Gender × Group differences in performance in a sample of anterior temporal lobectomy (ATL) patients. Subjects were language nondominant (LND) ATLs ($n = 14$, 6 males, 8 females) or language dominant (LD) ATLs ($n = 9$, 3 males, 6 females). Results indicated that the performance of LNDATL females did not differ significantly from their LDATL female counterparts on any of the performance variables and differed from LDATL males on only one. The performance of LNDATL males, however, was significantly impaired compared to LNDATL females, LDATL males and females on all performance measures. These results suggest that the spatial mapping abilities of LND males may be differentially affected by resection of the LND hippocampus. A pre- and post-surgical design is the next step in this ongoing study.

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F.A. WOLKENBERG. Do Men and Women Arrive at the Same Place By a Different Route: Differences Between the Sexes in Serial *versus* Simultaneous Access to the Lexicons.

There is increasing evidence of neuroanatomical differences between men and women in right hemisphere temporal lobe organization. Functional differences between the sexes in language processing, although well documented, have been a contentious issue and difficult to characterize in relation to lateralized lexical access. This study reports an attempt to replicate and expand upon an earlier finding, in which women demonstrated facilitation in a lexical decision task when primes were unrelated to target words, while men did not. In the first experiment (49 women, 39 men), primes and targets were separated by long (500 ms) stimulus onset asynchronies (SOAs), and in the second (24 women, 23 men) by short (150 ms) SOAs. Each target was preceded by either a related or an unrelated word, or by a neutral stimulus. Prime-target pairs were identical between the 2 new experiments. The original finding, that women were facilitated by nonwords, was replicated; however, when word frequency was taken into account, in the long SOA condition both sexes demonstrated facilitation by low frequency primes, but only women demonstrated facilitation by high frequency primes. In the short SOA condition, interference occurred that mirrored patterns seen in the long SOA condition. Data on associative priming, which was only seen in women in the short SOA condition is also considered. Taking into account previous research and anatomical data, we conclude that women may have simultaneous bilateral access to representations of words, while men demonstrate preferred left hemisphere access, with sequential right hemisphere access dependent on task demands.

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T. ALLISON, D. MADSEN, & E. ZAIDEL. Task-Specific Enhancement of Left Hemisphere Performance by Cigarette Smoking.

It has been theorized that the effects of smoking on affect and cognition are related to a change in the balance of activation in the cerebral hemi-

spheres. We tested this theory in 28 dependent smokers, using 3 different tasks. The lexical decision and Stroop tasks used lateralized tachistoscopic visual stimuli, while the dichotic listening task used auditory stimuli. Subjects performed each task during satiety and also following 16 hours of abstinence. Performance was compared between these 2 states to assess the effects of smoking. Reaction time and accuracy were analyzed using ANOVA. For dichotic listening and lexical decision, there were no interactions with state. In keeping with our previous findings, however, there was a significant interaction for accuracy in the Stroop task between state, visual field, and congruence ($p = .03$). During satiety, subjects were not affected by color-word incongruence, which did cause increased errors during abstinence. This effect was seen only for words presented to the right visual field, suggesting that the left hemisphere mediates cognitive changes between smoking and withdrawal. The fact that smoking influenced Stroop performance, but not lexical decision or dichotic listening, suggests that while it may produce hemispheric effects, these are dependent on modulation of specific resources, such as selective attention, rather than an overall shift in cerebral activation.

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J.M. KEILLOR, J.G. HOLLANDS, & T.P.S. VIRK. Choice of Reference Points Underlies Sex Difference in Orientation Judgments.

Large sex differences have been documented in judgments of line orientation. The psychophysical literature shows that when judged orientation is plotted against actual orientation, cyclical bias patterns are typically found, and much of the error in orientation judgments results from the cyclical patterns. The Cyclical Power Model (CPM) proposes that the subjective choice of available reference points determines the number of cycles in the bias pattern. When observers use more reference points, the number of cycles in the bias pattern becomes larger, and more closely approximates a linear function. Therefore, as more reference points are used, the overall amount of error (deviation from linearity) is reduced. To determine whether such differences in the number of cycles underlie sex differences in accuracy, 34 male and 34 female observers judged the orientation of a line by extrapolating its position on a response circle. To obtain reliable data, each observer completed over 2000 judgments across 2 sessions. Male observers were significantly more accurate at making the orientation judgments. Model fitting revealed that for most male observers an 8-cycle pattern fit best, whereas for most female observers a 4-cycle pattern predominated, suggesting reliance on the 4 canonical orientations (up-down, left-right). These results indicate that sex differences in a simple visuospatial task may result from differences in the choice of reference points, and error on such tasks may be best explained by systematic patterns of bias that differ between individuals.

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J.S. McGEE, G.M. REGER, A.A. RIZZO, M. THIEBEAUX, C.D. VAN DER ZAAG, & J.G. BUCKWALTER. The Virtual Environment Visuospatial System: Gender Differences in Older Adults.

The USC Virtual Environment (VE) Visuospatial System consists of a series of neuropsychological assessment instruments which assess the following spatial abilities in a 3D VE: simple visual reaction time, depth perception, field dependence, and spatial rotation. In this study, gender differences in performance on these VE measures were examined in older adults (15 men, 15 women). Consistent with the literature, findings reflected a trend for men to respond more quickly than women on simple visual reaction time ($p = .09$). No significant gender differences on depth perception were noted. On the virtual rod-and-frame test, women were significantly more field dependent than men ($p = .004$). Further, women performed more slowly than men on the virtual spatial rotation test (VSRT; $p = .05$). A trend was noted, however, for women to perform more efficiently ($p = .09$). Analysis of the relationships between VSRT indices (speed and efficiency) and more traditional neuropsychological measures yielded a potential explanation for this pattern. Women's VSRT scores had strong associations with untimed and nonverbal reasoning tasks, suggesting that they spent time analyzing the VSRT, responding when confident, resulting in slower but more efficient performance. Alternatively, men's performance correlated highly with timed tasks requiring manual manipulation. Thus, they may have utilized a faster, more active, trial-and-error response style at the expense of efficiency. It is also possible that greater motor capacity or processing speed may underlie men's quicker performance. Findings hold implications for accurate assessment and cognitive rehabilitation of older men and women in VEs.

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D. ANDREWS, S. AITKEN, C. PARR, B. HARRIS, & A. KAYE. Laterality of Emotional Dysfunction According to Gender in Patients Following Brain Surgery.

Thirty-seven males (20 left lesion, 17 right lesion) and 60 female (30 left lesion and 30 right lesion) brain surgery patients and 48 extra cerebral neurosurgery and cancer patient controls were rated by their partners on the Emotional and Social Dysfunction Questionnaire (ESDQ). The groups and lateralized subgroups were equivalent for age, education, and time since surgery. A combined MANOVA analysis of the Anger, Helplessness, Indifference, Inappropriate, and Fatigue Scales indicated a significant main effect for gender ($< .01$). *Post-hoc:* Sheffe comparison of left *versus* right lesion ratings for the female group indicate higher ratings of both groups on the Anger scale compared to controls ($< .01$). However there were also greater dysfunctional ratings of the left lesioned group on the Helplessness ($< .05$) and Indifference ($< .05$) scales compared to the right and controls. In contrast, the males showed more emotional problems following a right lesion. Both left ($< .001$) and right ($< .01$) brain lesioned male groups performed more poorly compared to controls on the Anger scale. On the Inappropriate scale the male group with right lesions were rated more poorly compared to the left ($< .01$) and compared to controls ($< .001$). The results follow previous studies finding more negative affect associated with left lesions and more inappropriate behavior following right lesions, however this is the first time that laterality differences have been gender related.

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C. FLAHERTY-CRAIG & P. ESLINGER. Design Fluency: Relative Advantage Demonstrated in a Normal Left Handed Female Sample.

Nonverbal fluency is evidenced to be mediated by right hemisphere anterior cortical networks, analogous to word fluency mediation by left frontal cortical regions (Jones-Gotman & Milner, 1977). By contrast, in right-handed subjects, drawing disability results from unilateral lesions in either hemisphere (Warrington et al., 1966). It was hypothesized that (1) superiority in nonverbal fluency would associate with sinistrality and (2) female sinistrality would associate with an even greater frontal cortical mediated design fluency advantage, analogous to the male parietal cortical mediated advantage in spatial perception demonstrated in normal male children (Lindgren & Benton, 1980) and adults (Benton et al., 1977). Ninety-six healthy adolescents were tested for their ability to produce abstract designs under free conditions for a fixed time period. The sample was comprised of 4 groups of 24 15–16-year-old subjects as follows: left-handed females, right-handed females, left-handed males, right-handed males. *T*-test results evidenced a left-handed advantage over right-handers ($p < .0008$), while sex differences were not evident for generation of abstract designs ($p = .287$). However, left-handed females demonstrated an advantage over both right-handed males ($p < .0001$) and females ($p < .0001$). No such advantage was evident for left-handed males in comparison to right-

handed males ($p = .116$), while it remained evident in comparison to right-handed females ($p < .00001$). Thus, fluency for designs appears to be associated with both handedness and gender, with both left-handedness and female gender associated with superiority for this right frontal cortical mediated capacity.

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Symposium 7/3:30–5:15 p.m.

CONTEMPORARY ISSUES IN THE CONCEPTUALIZATION AND ASSESSMENT OF WORKING MEMORY AND EXECUTIVE FUNCTIONS

Organizer: Julie C. Weitlauf
Chair: Neil Pliskin

A. MIYAKE. Executive Functions, the Phonological Loop, and Neuropsychological Testing.

In this presentation, I will make 2 theoretical claims about so-called executive functions and discuss their implications for neuropsychological assessment and testing. The first claim concerns the unitary *versus* nonunitary nature of executive functions. Executive functions are often linked to the central executive system in Baddeley's (1986) influential model of working memory (WM). Although the central executive had a strong unitary flavor in its initial conceptualization, recent research indicates that executive functions are not completely unitary. Moreover, different executive functions contribute differentially to performance on prevalently used neuropsychological tests of executive functions, such as the Wisconsin Card Sorting Test (WCST) and the Tower of Hanoi (Miyake et al., 2000), suggesting a need for caution in using complex neuropsychological tests like the WCST to evaluate the integrity of executive functions in patients. The second claim concerns the role of the phonological loop in executive control. The phonological loop is a subsystem of WM responsible for temporary maintenance of phonological information and is often associated with inner speech. Although it has been characterized as a passive "slave" system, recent evidence suggests that it supports executive functions in important ways. For example, recent studies (including those from our lab) demonstrate that making the use of the phonological loop difficult (by requiring concurrent articulation) severely impairs performance on executive tasks among normal adults, including task switching and the WCST. Such findings are consistent with Luria's proposal on the regulatory function of language and point to an important role of the phonological loop in executive control.

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R.W. ENGLE. Individual Differences in Working Memory Capacity.

Working memory is a system for maintaining information in an active, easily retrievable state and is particularly important for dealing with the effects of interference and distraction on cognition. The system consists of a variety of structures for domain-specific representations, their associated rehearsal buffers, and a domain-general executive attention system. There is good evidence that individual differences in the executive attention system of working memory (otherwise known as working memory capacity) reflect the mechanism for general fluid intelligence. Further, these individual differences in working memory capacity appear to reflect functioning of a frontal executive attention system consisting of several brain structures including the prefrontal cortex and the anterior cingulate, along with a structure lower in the brain that is important to arousal and mental effort. Working memory capacity has been shown to be important in a wide variety of complex cognitive tasks such as reading comprehension and listening comprehension at molecular and molar levels, learning to spell, following directions, vocabulary learning, note taking, writing, reasoning, and complex learning (a week long computer-aided course in programming in PASCAL). Recent work from our lab has focused on the role of working memory capacity on both higher-order cognitive tasks, and low-level attention tasks. Working memory capacity and domain expertise interact in an overadditive manner such that working memory capacity becomes even more important with greater levels of domain expertise. At the basic attention level, individual differences in working memory capacity are important to performance on Stroop, vigilance, and basic visual attention tasks.

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K. KLEIN. The Effect of Unwanted Thoughts About Stressful Events on Cognitive Processes.

Intrusive thoughts and attempts at their suppression result from or perpetuate a number of emotional disorders and pathologies following exposure to traumatic or stressful events. Such unwanted thoughts are also associated with impairments on cognitive tasks, including analogical reasoning, decision making, and most importantly, working memory (WM) and executive function tasks. This presentation presents evidence (a) that people who have recently experienced large numbers of stressful life events demonstrate impaired performance on these tasks; (b) that greater cognitive impairments are associated with reports of more unwanted thoughts about a stressful event, but not with thoughts about the stressor during the task; (c) that people instructed to suppress unwanted thoughts about stressful events perform more poorly on an executive function task compared to people asked to suppress neutral or nonpersonal emotional thoughts, even though reports of suppression failures (intrusions) do not differ between groups; and (d) instructing people to create a coherent causal account about the stressful event produces reliable WM improvements, apparently arising from a decrease in intrusive and avoidant thinking about the event. The data suggest that attempts to suppress memories of stressful or traumatic events can impair the very cognitive processes needed to cope effectively with these events. Therapeutic interventions that encourage the development of a coherent narrative about a stressful event can alter its cognitive representation, making its suppression less demanding of limited attentional resources, freeing these resources for more effective problem solving.

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E. TWAMLEY, R.K. HEATON, B. PALMER, & D. JESTE. Is Working Memory the Core Deficit in Schizophrenia?

Some researchers assert that working memory impairment is a core deficit underlying many of the features of schizophrenia, a notion consistent with neuropsychological models of the disorder that implicate frontal lobe dysfunction. Supporting this view, previous research has demonstrated associations between working memory performance and a variety of clinical features of the disorder, including negative symptoms, thought disorder, language comprehension, delayed recall, and abstraction ability. We have examined working memory and other neuropsychological deficits in our studies of middle-aged and older schizophrenia patients (age 40 and above) and have found that impairment in working memory abilities is indeed common in this population (71% impaired) and is associated with other neuropsychological and functional impairment. The degree to which memory deficits reflect a generalized deficit rather than a specific one, however, remains uncertain. For example, although scores on working memory and learning tests are correlated, learning ability is a significant predictor of everyday functioning in terms of social activity level and subjective symptoms of physical and mental illness, whereas working memory is not. Verbal learning ability, more than working memory, is strongly associated with performance of functional skills and with commonly used tests of executive functioning (Category Test and Wisconsin Card Sorting Test). Difficulty interpreting the literature on working memory in schizophrenia may stem from (a) conceptual ambiguity about what working memory is

and how it should be measured, and (b) the degree to which brain-related abilities are determined by a general factor, resulting in high intercorrelations among neuropsychological test scores.
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J. WEITLAUF, N. PLISKIN, A. CONWAY, & J. FINK. Working Memory and General Intelligence, Implications for Understanding ADHD.
A vexing problem for the neuropsychological community has been to identify the specific neuropsychological profile that characterizes adults with attention deficit hyperactivity disorder (ADHD). While poor performance on traditional tasks of attention, working memory, and executive function may distinguish ADHD patients from healthy individuals, it does not clarify the specific clinical presentation of ADHD as a disorder with a distinct pattern of cognitive weaknesses. The authors of the present study suggest those group level differences between adults with ADHD and their healthy peers provide only preliminary evidence for differences between these populations. An additional level of analysis that holds promise for diagnostic efficacy may be the intraperson patterns of consistency and variability on such tasks. More specifically, rather than seeking a specific pattern of cognitive weaknesses, what may be ultimately most distinctive of the psychological functioning of adults with ADHD is the interrelationship among core cognitive functions like working memory, attention, executive function, and intelligence. While a growing body of research indicates that working memory is an excellent predictor of general fluid intelligence in healthy adults, our research indicates that this relationship is violated in adults with ADHD. In the present study, the authors compared performance on tasks of working memory, executive function, attention, intelligence, and emotional functioning in adults with ADHD, adults with chronic pain disorders, and healthy adults. Preliminary results reveal that working memory, attention, and executive ability may be excellent predictors of intelligence in both healthy adults and chronic pain patients, but are poor indicators of intelligence in ADHD patients. The implications of these findings for both (a) understanding the relationship between working memory and intelligence (and the nature of individual differences in both working memory and intelligence); and (b) understanding the role of working memory in the cognitive and behavioral deficits typically associated with ADHD will be discussed.
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Symposium 8/3:30–5:15 p.m.

SEMANTIC MEMORY AND TEMPORAL LOBE EPILEPSY

Organizer and Chair: Brian D. Bell

B. BELL, A.R. GIOVAGNOLI, G. GLOSSER, R. MARTIN, S. SAWRIE, M. SEIDENBERG, & S. SWANSON. Semantic Memory and Temporal Lobe Epilepsy.
Episodic memory has long been a focus of neuropsychological study in individuals with temporal lobe epilepsy (TLE). This body of research greatly advanced clinical and theoretical understanding of the relationship between the mesial temporal lobe and episodic (autobiographical) memory. Less attention has been devoted to semantic (culturally shared) memory in TLE patients. This cognitive domain appears to be a potentially important and fertile area of research in TLE, because the study of other neurological patient populations (e.g., semantic dementia) has indicated that the lateral temporal lobe plays a vital role in semantic memory, volumetric and metabolic abnormalities of the lateral temporal lobe are common in TLE, and preliminary results from the TLE literature suggest that performance in this domain is compromised in some patients. The intent of this symposium is to introduce current data and stimulate additional research related to semantic memory ability in TLE. Data will be presented concerning: (1) fMRI activation during a semantic decision task, including effects of age at onset and side of seizure focus on language lateralization; (2) temporal lobe fMRI activation during lexical processing, including category specific effects in healthy controls; (3) clinical and theoretical implications of the relationship between mesial temporal MRS and volumetric MRI findings and standardized semantic memory tests; (4) the relationship between quantitative MRI measurements of lobular gray and white matter volumes and performance on experimental semantic knowledge tasks; and (5) semantic memory test performance by modality and laterality of seizure focus in TLE and frontal lobe epilepsy patients.
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S. J. SWANSON, J.R. BINDER, E.T. POSSING, T.A. HAMMEKE, D.S. SABSEVITZ, M. SPANAKI, I.M. RUFF, G.L. MORRIS, & W.M. MUELLER. fMRI Language Laterality During a Semantic Task: Age of Onset and Side of Seizure Focus Effects.
Early onset of epilepsy in the left hemisphere can result in hemispheric reorganization of language. In the present study we examined (1) the effects of age at onset of seizures on language lateralization indexes (LIs) as determined using an fMRI semantic decision task and (2) the relationship between preoperative naming abilities and fMRI LIs. FMRI LIs were calculated (L−R/L+R) for whole brain, lateral, frontal, and temporal regions of interest (ROIs). Subjects were 61 patients with right- and 66 patients with left-sided seizures. Of these, 58 had early (age ≤ 5) and 68 had late (age > 5) seizure onset. Results indicate a significant correlation ($r = .36$, $p = .023$) between age at onset of seizures and LIs for patients with left-sided seizures using the whole brain ROI and no correlation in patients with right foci. Preoperative Boston Naming Test (BNT) scores correlated significantly with fMRI for the whole brain and lateral LIs for the combined left and right seizure group with the highest correlation being found between the temporal LI and BNT in the left seizure group ($r = .34$, $p = .001$). Correlations were also found for the early and late onset groups between BNT and the temporal and lateral ROIs, respectively. These results indicate that (1) earlier age at onset of epilepsy in the left hemisphere is associated with more atypical or right hemisphere language on fMRI, (2) patients with left seizure foci whose language has reorganized have poorer naming abilities, and (3) ROI analyses may elucidate the effects of seizures beginning at different ages on language.
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G. GLOSSER, N.D. CHIAVARALLOTI, M. FARAH, M. GROSSMAN, P. KOENIG, & L. TIPPETT. Fractionation of Lexical Semantic Processing Within the Left Temporal Lobe.
Impairments in naming and other language functions are well-recognized symptoms of left temporal lobe epilepsy (LTLE), and such problems often increase in severity following left anterior temporal lobectomy (LATL). In the past, the anomia in LTLE had been interpreted to reflect a problem in lexical retrieval. Recent studies of LTLE patients have shown, however, that the naming disturbance differs for various categories of words. Such category-specific naming disturbances raise the possibility that at least some of the anomia in this patient group is the result of semantic, rather than lexical, disruption. Two sets of data from LATL patients will be presented; one showing a selective deficit in the naming of nonliving as compared to living things, and another showing a selective deficit in concrete and abstract noun naming, with apparent sparing of verb naming. A semantic impairment underlying some of these language problems is indicated by the abnormal performances of LATL patients on tasks requiring semantic judgments about nouns, especially abstract nouns, but not verbs. Data from functional MRI studies of 16 healthy young people provide

further confirmation of differentiation of lexical semantic processing within the left temporal lobe. These data show differential temporal lobe activation during the processing of abstract nouns and words naming implements, when compared to words naming animals. Consistent with lesion data, left lateral temporal lobe activation was associated with semantic processing of abstract nouns and implements, but not animals. Together these results indicate fractionation of the lexical semantic processing system within the left temporal lobe.

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S. SAWRIE & R. MARTIN. Hippocampal Contributions to Semantic Memory in Patients with Mesial Temporal Lobe Epilepsy.

Prior studies have established a strong link between semantic memory and the lateral temporal lobe. However, the relationship between mesial temporal lobe structures and semantic memory is much less conclusive. Prior research from our center found significant relationships between measures of semantic memory (Boston Naming Test: BNT; WAIS–R Comprehension subtest: COMP) and the metabolic integrity of the right and left hippocampus as operationalized by proton magnetic resonance spectroscopy (1H–MRS) in patients with mesial temporal lobe epilepsy (TLE) (Sawrie et al., 2000). A neural network model of left hippocampal Cr/NAA as a function of both semantic and episodic memory scores had explained 60.8% of the variance. Since metabolic integrity of the hippocampus appears to play a possible role in semantic memory performance, we further explored this potential association by examining the relationship between the structural integrity of the mesial temporal lobe and semantic memory. MRI volumetric measurements of the right and left hippocampus, amygdala, mammillary bodies (MB), and fornix were collected in 78 patients with either left or right TLE. Patients were either right-handed or had Intracarotid Amytal Procedure confirmation of left speech dominance. Significant correlations were found between the BNT and the left hippocampus ($p < .0001$), left fornix ($p < .035$), right fornix ($p < .036$), and right MB ($p < .008$), while left hippocampus was associated with COMP performance ($p < .028$). These data suggest that the limbic memory system, particularly left hippocampus, may be a constituent of the overall biological neural network of semantic memory. Implications and future research venues will be discussed.

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B. BELL, C. DOW, J.E. JONES, A. WOODARD, R. SHETH, P. RUTECKI, B. HERMANN, & M. SEIDENBERG. Semantic Memory and Temporal Lobe White Matter Volume in Temporal Lobe Epilepsy.

We previously reported (Bell et al., in press) that temporal lobe epilepsy (TLE) patients, compared to controls, demonstrated impairment on tests of object naming and semantic knowledge production for a selected sample of the target objects. Semantic knowledge was the only significant predictor of object naming ability. In this study, we further explored the relationship between object naming and other semantic memory ability in a subsample of TLE patients and controls (total $N = 61$) by testing semantic knowledge recognition for the same target objects. In addition, this study analyzed the relationship between object naming and semantic knowledge production and quantitative MRI volumes of cortical gray matter and white matter by lobe and by hemisphere. The TLE group performed significantly worse compared to controls on the multiple-choice semantic knowledge recognition test. There were significant correlations among the 3 semantic memory measures for both controls ($r = .50$ to $.65$) and patients ($r = .54$ to $.56$). For the TLE patients ($n = 50$), strong zero-order correlations were present for both parietal and temporal lobe volumes, but bilateral temporal lobe white matter volume was the significant predictor of semantic knowledge production ($R^2 = .22$, $p = .001$) and left temporal white matter was the significant predictor of object naming ability ($R^2 = .12$, $p = .01$). Thus, at the group level, object naming impairment in TLE is associated with a more general semantic memory deficit. Semantic memory ability in TLE is significantly associated with lateral temporal lobe white matter volume.

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A.R. GIOVAGNOLI. Verbal and Nonverbal Semantic Memory in Patients With Temporal and Frontal Lobe Epilepsy.

Previous studies have revealed deficits in semantic analysis, categorization, encoding, and retrieval in patients with left temporal lobe epilepsy (TLE). Nevertheless, the hypothesis of verbal and nonverbal semantic impairment in patients with temporal and extra-temporal lobe epilepsy has been rarely addressed using specific tests. Another area of uncertainty is the comparison between patients with lateral and mesial temporal lobe lesions. In this study, 138 right-handed patients with left ($n = 54$) or right ($n = 44$) TLE, associated with mesial or lateral temporal lobe lesion or without overt lesions on MRI, were compared to 40 patients with frontal lobe epilepsy (FLE) and 35 healthy subjects. The Object Decision Hard, verbal and visual Pyramid and Palm Trees test, card classification, picture naming, picture pointing, and drawing from memory were used to assess semantic memory. In epilepsy patients, factor analysis revealed that all of the tests used for semantic memory pertained to one factor. Compared to controls, the left and right TLE patients showed impaired verbal and visual semantic memory, respectively, and these deficits were significant in the left TLE patients with cortical lateral or mesial lesions and right TLE patients with lateral lesions. The left FLE patients were impaired in picture naming. In conclusion, left and right temporal lobe lesions associated with epilepsy may cause selective semantic memory impairment, although naming deficits may also be induced by left FLE. Lateral and mesial temporal lobe lesions may give rise to the same deficits suggesting that both regions contribute to semantic memory functioning.

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FRIDAY MORNING, FEBRUARY 16, 2002

Poster Session 4/8:00–10:45 a.m.

AUTISM

K. RENNIE, B. CORBETT, & T. HARRISON. Asperger Syndrome *versus* Nonverbal Learning Disability.

Over the past few years, diagnostic methodology for pediatric populations has become more sophisticated with the development of new instruments and more stringently defined criteria for making diagnosis. However, while diagnostic techniques have improved, it is still difficult to differentiate between disorders with similar symptomatology. Specifically, there has been much debate in recent years over the distinction between Asperger syndrome (AS) and nonverbal learning disability (NVLD). Some have hypothesized that AS and NVLD are simply on a continuum of right cerebral hemispheric dysfunction. Yet, others posit that AS and NVLD are 2 distinct disorders. In support of the latter argument, it is pointed out that AS is a psychological diagnosis while NVLD is a neuropsychological diagnosis. That is, the diagnosis of AS is based upon the Diagnostic and Statistical Manual (DSM), which outlines a list of behavioral symptoms

with no mention of neuropsychological functioning. In order to make a diagnosis of NVLD, however, there needs to be a pattern of deficits in visual processing skills based upon neuropsychological testing. The purpose of the current paper is to assist in making differential diagnosis between AS and NVLD through use of neuropsychological profiles. The neuropsychological profiles of 18 participants diagnosed with AS and 20 diagnosed with NVLD will be presented.
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L. KENWORTHY, T. AHLUVALIA, G. WALLACE, A. WAGNER, L. GILOTTY, & K. TOWBIN. Visual Organization Deficits in High-Functioning Autism and Asperger Disorder.
Many studies describe executive dysfunction (EF) in children with high functioning autism (HFA). There are fewer investigations of Asperger syndrome (AS), but recent data fails to distinguish it from HFA on executive measures. The organization subdomain of EF has not been thoroughly investigated and has important implications for intervention. We hypothesized organization deficits in both HFA and AS. Two experienced clinicians reviewed charts of 25 HFA and 23 AS patients who had been consecutively evaluated in a neuropsychology service to confirm autism diagnoses (DSM–IV criteria used). All patients had FSIQ $\geq$ 70. Groups matched on age (HFA M = 10.7, range = 6–17 years; AS M = 9.9, range 7–16 years), PIQ (HFA M = 94.7; AS M = 99.5) and sex ratio (23 HFA males, 22 AS males). As part of their evaluations, patients completed the Rey-Osterrieth Complex Figure, Beery-Buktenica Developmental Test of Visual-Motor Integration (VMI), and WISC–III Perceptual Organization Index. Rey figures were assigned Bernstein-Waber organization scores. The HFA and AS groups combined showed deficits on the Rey (M = 80.4($\pm$15)) relative to their own Beery (M = 91.8(11); p = .01), and Perceptual Organization Index Scores (101.2(17.3); p = .0001). There were no significant differences between the HFA and AS groups. The Beery and Rey both tap visual motor integration and require replication of abstract visual designs. The Rey requires organization of a more complex data set than the Beery. The fact that children with HFA and AS perform significantly worse copying the Rey than the VMI supports the hypothesis of organizational deficits in these groups.
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L. KENWORTHY, G. WALLACE, L. GILOTTY, T. AHLUVALIA, A. WAGNER, & K. TOWBIN. Superior Verbal Databases: An Island of Linguistic Strength in Asperger Syndrome.
The distinction between Asperger syndrome (AS) and high functioning autism (HFA) is controversial. DSM–IV criteria emphasize intact early language in AS. Many argue that AS is differentiated from HFA only by higher verbal intelligence and is simply a "higher" form of high-functioning autism. We hypothesize that children with AS are not able to translate their excellent verbal databases into functional communicative capacities. Two experienced clinicians reviewed charts of 25 HFA and 23 AS patients who had been consecutively evaluated in a neuropsychology service to confirm autism diagnoses (DSM–IV criteria used). All patients had FSIQ $\geq$ 70. Groups matched on age (HFA M = 10.7, range = 6–17 years; AS M = 9.9, range 7–16 years), PIQ (HFA M = 94.7; AS M = 99.5), and sex ratio (23 HFA males, 22 AS males). As part of their evaluation, the groups completed a range of language related measures. The AS group was significantly superior to the HFA group on the WISC–III Verbal Comprehension Index (p = .004), semantic fluency (p = .002), CVLT Immediate Recall (p = .02), and WRAML Sentence Memory (p = .0001). There was no difference between the HFA and AS groups on the Vineland Adaptive Behavior Scale Communication domain, phonemic fluency, or CVLT semantic cluster scores. These data support the view that excellence with repeating and remembering words, facts and sentences in the AS group is an isolated linguistic strength. Children with AS are subject to organizational and functional language deficits equivalent to those in HFA.
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L. GILOTTY, A. WAGNER, T. AHLUVALIA, L. KENWORTHY, G. WALLACE, & K. TOWBIN. Adaptive Skills and Executive Function in Asperger's Syndrome and Autism.
Recent empirical research with children with high-functioning autism (HFA) and Asperger's syndrome (AS) has suggested that these disorders are caused by impairments in executive functioning (EF). Investigators have examined numerous behavior variables to determine whether or not a relationship exists between EF and autistic symptomatology. This study examined the relationship between adaptive skills, as measured with the Vineland Adaptive Behavior Scales, and EF, as measured with the Behavior Rating Inventory of Executive Function (BRIEF). It was hypothesized that scores on the Vineland would be negatively correlated with scores on the BRIEF, as higher scores on the BRIEF indicate increased executive dysfunction. Subjects were 48 children with HFA or AS, between 6–17 years of age (M = 10.3 years, SD = 2.7), who were consecutively evaluated in a neuropsychology service. Diagnostic confirmation based on DSM–IV criteria was obtained using 2 independent clinicians. Parents of participants were interviewed with the Vineland, and asked to complete the BRIEF-Parent form. The Vineland Communication Domain correlated with the Initiate (r = $-$.56, p = .008), Working Memory (r = $-$.47, p = .03), and Metacognition (r = $-$.54, p = .011) scales of the BRIEF. The Vineland Daily Living Domain correlated with the Initiate scale (r = $-$.50, p = .019). The Vineland Socialization Domain correlated with the Initiate (r = $-$.55, p = .004), and Working Memory (r = $-$.48, p = .016) scales. The Vineland Adaptive Behavior Composite correlated with the Initiate (r = $-$.61, p = .009), the Working Memory (r = $-$.69, p = .002), and Metacognition (r = $-$.58, p = .015) scales. Thus, several significant relationships were found between adaptive skills and executive functioning.
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T. AHLUVALIA, L. KENWORTHY, A. WAGNER, G. WALLACE, L. GILOTTY, & K. TOWBIN. Working Memory in High-Functioning Autism and Aspergers Syndrome.
Recent research suggests executive dysfunction as a central cognitive deficit in autism. Working memory, an aspect of executive functioning, has received little attention in this literature. We hypothesized working memory deficits in both HFA and AS, but that the 2 groups would be equivalent on working memory measures. Participants consisted of HFA (N = 25) and AS Diagnoses were confirmed by independent chart review by 2 experienced clinicians using DSM-IV criteria. Groups matched on age (range = 6–17) years; HFA M = 10.7; AS M = 9.9), PIQ (M = 96.9, SD = 15.8), and gender (23 HFA males, 22 AS males). All subjects had FSIQ $\geq$ 70. Subjects completed the WISC–III and Children's Memory Scale Dot Locations (DOTs) subtest. Parent and teacher BRIEFs (Behavior Rating Inventory of Executive Function) were completed. The findings were mixed: In the combined AS and HFA groups, there was a significant difference between Digit Span and the Verbal Comprehension Index of the WISC–III (t = $-$2.23, p = .03), indicating a relative weakness on a subtest sensitive to working memory. Also, the Working Memory subscales of the parent (t = 5.2, p = .00) and teacher (t = 6.9, p = .00) BRIEFs were significantly impaired relative to the normative sample. However, the combined AS and HFA groups performed within the average range on Dots, a measure sensitive to visual working memory. The HFA and AS groups were not significantly different on any of the working memory measures used. Overall, the results suggest the need for further investigation of verbal versus visual working memory in HFA and AS.
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G. WALLACE, A. WAGNER, L. KENWORTHY, T. AHLUVALIA, L. GILOTTY, & K. TOWBIN. Does the Nonverbal Learning Disabilities Model Differentiate Asperger Syndrome and High-Functioning Autism?

Previous research has implicated the nonverbal learning disabilities model (NVLD) as a way to differentiate Asperger syndrome (AS) from high-functioning autism (HFA). However, very little empirical evidence exists to either corroborate or disconfirm this hypothesis. Utilizing strict DSM–IV criteria to define groups, it is hypothesized that the NVLD model, particularly those functional subdomains that discriminated groups in previous studies, will not differentiate AS from HFA. The subjects were 25 HFA and 23 AS patients consecutively evaluated in a neuropsychology service. Through a review of charts, 2 independent and experienced clinicians confirmed diagnoses. Subjects with FSIQ < 70 were excluded. Groups were matched on age (HFA $M = 10.7$; AS $M = 9.9$), PIQ (HFA $M = 94.7$; AS $M = 99.5$) and sex ratio (23 HFA males, 22 AS males). The neuropsychological battery included the Beery-Buktenica Developmental Test of Visual-Motor Integration, Judgment of Line Orientation, Wisconsin Card Sorting Test, Children's Memory Scales, Verbal Fluency, Phoneme Segmentation, WISC–III, and CVLT–C. Results reveal that the 2 groups were equivalent in terms of visual motor integration ($p = .69$), visual-spatial perception ($p = .33$), nonverbal concept formation ($p = .47$), and visual memory ($p = .11$). Furthermore, verbal output ($p = .20$), auditory perception ($p = .10$), and verbal memory ($p = .29$) did not differ between groups. Vocabulary was the sole domain to reveal group differences ($p = .00$) and is thought to reflect the superior verbal skills of the AS subjects. These findings fail to support the NVLD model of AS, calling into question the neuropsychological differentiation between AS and HFA.

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E. KELLEY, A. JANOVICZ, L. MAYEUX, J. OMDOLL, D. VEAR, L. NAIGLES, & D. FEIN. An Examination of the Language Capabilities of Children with a History of Autism.

This research was undertaken to compare the language capabilities of 2 groups of children: those who have been developing normally since birth, and those who were diagnosed with autism as toddlers, but who have participated in extensive Applied Behavior Analysis (ABA) and are now considered to be within the normal range in their intellectual functioning. Although these children are now considered to be functioning within normal range, no comprehensive analysis of their language abilities had been conducted. This study examined these children's language capabilities in detail, examining their understanding of the overall lexicon, noun categories, verb argument structure, morphology, complex syntax, mental state verbs, verbal memory, Theory of Mind, and narrative ability. Both standardized tests and criterion-referenced informal measures were used. A typically developing control group was also tested, matched for age, sex, and SES. An in-depth profile of each of the children with a history of autism will be presented, and comparisons between these children and the control group will be discussed. As the children with a history of autism learned language in a very different manner than that of their typically developing peers, their current language capabilities have much to teach us about atypical language acquisition, as well as whether or not these children are still experiencing difficulties. Although the majority of the children formerly diagnosed with autism performed very well on the standardized tasks, they continue to experience subtle difficulties in language performance, particularly in more complex areas of language.

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B. CORBETT & E. LARSSON. The Merging of Neuropsychological Data and Applied Behavior Analysis in Autism.

Autism is a neurobehavioral disorder with identified impairment related to several neural substrates including the cerebellum, frontal lobe, and the limbic system. The results are individuals who may have difficulty with any of the following: shifting attention, coordinating movement, making associations, perceiving and expressing appropriate affect, interpreting and using language functionally, and initiating behavior. The child with autism may be variously unable to organize, conceptualize, process, plan, and integrate information in a meaningful and consistent way. Children with autism spectrum disorders may variously require externally guided tasks, repetition, mass practice, structure, intense intervention, or considerable motivation to learn in order to prevent life-long deficits. These aforementioned techniques are at the foundation of Applied Behavior Analysis (ABA), considered the only treatment that has consistently demonstrated positive benefits for the long-term outcomes of children with autism spectrum disorders. A comprehensive neuropsychological evaluation provides valuable information for behavioral treatment and dependent measures in between-subject designs. Conversely, information gleaned from applied behavior analysis technology provides not only efficacious, individualized treatment for children with autism, but lends meaningful data for applied research and within-subject studies. The current presentation provides an overview of the merging of these disciplines in a complimentary and significant way. Case examples are presented as models of this integrated approach to the individualized assessment, treatment, and applied research in the study of autism spectrum disorders.

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D. ROBINS, D. FEIN, M. BARTON, J. GREEN, J. LORD, & A. JANOVICZ. M–CHAT: Longitudinal Perspective on Early Detection of Autism Spectrum Disorders.

The early detection of autism spectrum disorders is critical for optimal prognosis. The Modified Checklist for Autism in Toddlers (M–CHAT; Robins, Fein, Barton, & Green, 2001) is a parent-report checklist designed to detect autism and pervasive developmental disorder (PDD) at 24 months. Follow-up of the original sample of 1293 children is underway. To date, 31.2% of the original sample have been rescreened; no misses have yet been detected. Of the 6 children diagnosed at 2 years with nonautistic delays, 3 continue to show delays; 2 no longer show significant delays, and 1 now meets criteria for PDD–NOS. Of the 20 children diagnosed at 2 years with autism or PDD, 16 continue to meet criteria for autism or PDD, 3 now show nonautistic delays, and 1 no longer shows significant delays. The M–CHAT score at 2 years is significantly correlated with outcome at 4 years as measured by the Childhood Autism Rating Scale (CARS; $r = .476$, $p < .029$). M–CHAT at 2 years also significantly predicts clinical data at 4 years, including adaptive functioning as measured by the Vineland Adaptive Behavior Scales ($r_{\text{Comm}} = -.539$, $p < .009$, $r_{\text{Soc}} = -.505$, $p < .015$) and language as measured by the Preschool Language Scale–Third Edition ($r_{\text{Rec}} = -.484$, $p < .037$, $r_{\text{Exp}} = -.407$, $p < .085$). A simultaneous regression analysis indicates that the M–CHAT at 2 years tends to predict CARS at 4 years above and beyond measures of IQ and adaptive functioning ($\beta = .436$, $p < .086$).

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C. TANEJA, B. ROURKE, K. TSATSANIS, D. CICCHETTI, & A. KLIN. The NLD Scale: Distinguishing Between Subtypes of Pervasive Developmental Disorder?

The NLD Scale, developed by Rourke in 1993, is an instrument designed to assist in the diagnosis of nonverbal learning disabilities (NLD). The purpose of the present investigation, which uses the NLD Scale, was twofold. The first goal was to evaluate the validity of the NLD Scale, and the second goal was to determine if the NLD Scale could distinguish between individuals from 3 subtypes of pervasive developmental disorder (PDD): (1) high-functioning autism (HFA), (2) Asperger syndrome (AS), and (3) pervasive developmental disorder–not otherwise specified (PDD–NOS). Results suggest that the validity of the NLD Scale is adequate, indicating that the NLD Scale is a useful tool for identifying symptoms characteristic of the NLD syndrome. Next, the PDD groups were compared using 1-way between groups ANOVAs and Jonckheere's test of trend on each of the following NLD Scale measures: (1) neuropsycholog-

ical functioning, (2) academic achievement, (3) social-emotional and adaptive functioning, (4) total scores, and (5) individual questions. Group differences were significant on the section of the NLD Scale measuring neuropsychological functioning, verifying recent findings that individuals with AS, but not HFA, share neuropsychological characteristics with the NLD syndrome. However, subtypes of PDD were not differentiated by means of academic achievement, social-emotional and adaptive functioning, or total scores. Also, the PDD–NOS group did not differ significantly from either the HFA or AS groups on any of the NLD Scale sections. In addition, few individual questions significantly differentiated the 3 groups. Future research and clinical use of the NLD Scale are encouraged.
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C. SAULNIER, D. FEIN, M. LISS, & J. LORD. Sensory Reactivity in Children with Autism *versus* Typical Children.
Using the Sensory Survey, a 103-item scale measuring overreactivity, underreactivity, and stimulus-seeking behavior, abnormal reactivity to sensory stimuli has been shown to be common in autism but not in typical children. The Sensory Survey was administered to 223 parents of children with pervasive developmental disorders (PDD) and 195 parents of typical children. Parents were also administered the Vineland Adaptive Behavior Scales and the Kinsbourne Focus of Attention Rating Scale. The Sensory Survey has high reliability for both groups; Cronbach's alphas for the total scale were .94 and .95, respectively. MANOVA results indicated that children diagnosed with autistic disorder based on a DSM–IV checklist demonstrated significantly more overreactivity, underreactivity, and seeking behavior than typical children and children diagnosed with PDD–NOS [$F(3,410) = 864.9$, $p < .001$]. Hierarchical regression analyses indicated that the Sensory Survey adds unique variance to adaptive functioning in autism (but not typical children) above and beyond age, symptom severity, and overfocused attention as measured by the K–FARS. Results of a discriminant function analysis revealed a 75% predicted group membership rate for autistic disorder, PDD–NOS, and typical children based on sensory reactivity mean scores. Age trends in reactivity were also found for children with autism, but not for typical children. Factor analyses showed items to cluster by reactivity rather than sensory modality for both groups. Results indicate that abnormal sensory reactivity is prevalent in autism and is related to adaptive impairment, symptom severity, and overfocused attention. Abnormal responses to sensory stimuli do not appear to be prevalent in typical children.
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Poster Session 4/8:00–10:45 a.m.

ATTENTION

A. AMMAR, N. PLISKIN, J. FINK, I. CRAWFORD, & F. BRYANT. Memory and Attentional Functioning in Electrically Injured Patients With and Without PTSD Symptomology.
Electrical injury (EI) is currently recognized as one of the leading causes of occupational injury in the United States. Previous research has indicated that a significant proportion of EI survivors may experience a decline in memory and attentional functioning. However, these findings are further complicated by evidence that some survivors may also develop symptoms of posttraumatic stress disorder (PTSD), which has itself been associated with impaired cognitive performance. *Objective:* To examine memory and attentional dysfunction in EI survivors with and without PTSD. *Subject/Methods:* Analysis of variance was used to assess the performance of 148 EI patients (34 with PTSD; 114 without PTSD) and 29 noninjured electrician controls on the PASAT, Stroop Color Word Test, Trailmaking Test Part B, and CVLT. Variables of interest included initial encoding, delayed recall, anterograde verbal memory, verbal learning, recognition, susceptibility to intrusion, retroactive interference, working memory, distractibility, and sustained/selective attentional functions. *Results:* EI patients without PTSD demonstrated significant impairments in the ability to shift attention as compared to controls (Trails B; $F = 4.24$, df (1,135), $p < .05$). A trend towards deficits in working memory was also found among EI patients without PTSD when compared to controls (PASAT; $F = 2.47$, df (1,123), $p = .065$). A stronger trend was demonstrated when EI patients in general were compared to controls (PASAT; $F = 2.47$, df (3,137), $p = .052$). *Conclusions:* Electrically injured patients demonstrate significant deficits in attentional functioning as well as some mnemonic changes. Comorbid PTSD was not found to significantly contribute to functional deficits in the assessed domains.
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A. RIESTRA, G. CRUCIAN, K. WOMACK, & K.M. HEILMAN. Look, It Is Horrible! Role of Valence and Arousal in Initial Visual Exploration.
We wanted to learn whether initial attractiveness as measured by visual exploration time is related to the arousal induced by the stimulus and/or its valence. *Methods:* We used 2 sets of stimuli. One had high and low valence (pleasant and unpleasant) pictures controlled for arousal. Another had high and low arousal pictures controlled for valence. A geometric visual target was superimposed in one third of the pictures. These stimuli were randomly presented on a monitor to 19 normal subjects who were asked to explore each picture and report whether the geometric target was present. Response latency (RL) for the pictures without visual target was the dependent measure for exploration time. *Results:* Accuracy was at ceiling level for all conditions (>98%). The mean RL was greater for stimuli with high arousal (1852.38 ms) than for those with low arousal (1361.03 ms) ($p < .000$), and for stimuli with low valence (1862.49 ms) than for those with high valence (1735.73 ms) ($p = .007$). For all stimuli Pearson correlation of RL was 0.546 for arousal and −0.116 for valence. *Discussion:* Initial exploration correlated with stimulus' arousal and, to a lesser extent, with low valence. These findings oppose the notion that initial attractiveness is defined by high valence and help explain why approach behavior such as visual exploration may be directed towards unpleasant stimuli. The role of other stimulus' characteristics like complexity, incongruity, and novelty and their relationship to arousal and valence warrants further study.
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R.S. MACKIN, M.D. HORNER, & L. FLORES. Relationship of the Wender Utah Rating Scale to Objective Measures of Attention.
The Wender Utah Rating Scale (WURS) is a 25-item self-report questionnaire for the retrospective assessment of childhood ADHD symptoms for adults; high scores indicate greater symptomatology. The current study utilized 35 male outpatients from a VA medical center to determine if WURS scores were associated with objective measures of attention, including the Trail Making Test, Gordon Diagnostic System, WAIS–R Digit Span and Digit Symbol subtests, and WMS–R Mental Control subtest. Participants included both adults diagnosed with ADHD ($n = 14$) and non-ADHD adults ($n = 21$). After Bonferroni correction, Pearson correlations indicated that greater symptomatology on the WURS was associated with poorer Digit Symbol performance ($r = -.691$, $p < .01$) but better performance on Mental Control ($r = .518$, $p < .05$). To determine which indices best predicted WURS scores, scores on these tests as well as IQ and demographic variables were entered into a stepwise multiple regression; the Digit Symbol subtest was the only significant predictor of WURS scores ($R^2 = .59$, $p < .01$). Thus, poor performance on a nonspecific measure, but sensitive cognitive task was related to greater self-report of childhood ADHD symptoms.
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K. PRICE, M. JOSCHKO, & K. KERNS. Predicting Parent Reports of Adaptive Behavior Using Pediatric Tests of Attention.
Since the advent of sophisticated neuroradiological procedures, neuropsychology has increased its focus on understanding and predicting the cog-

nitive and functional outcomes of neurological disorders. While a number of studies have looked at the ability of general cognitive, memory, language, and visuospatial tests to predict real-world, or adaptive behavior, the role of attention has been largely overlooked. The present study examines the ability of a number of common pediatric attention tests to predict a criterion measure of adaptive behavior in an archival sample of 119 children referred for neuropsychological assessment (mean age = 11.2 years, ranging from 5 to 17 years). The overall score and 14 cluster scores of the parent-rated Scales of Independent Behavior–Revised (SIB–R; Bruininks, Woodcock, Weatherman, & Hill, 1996) were selected as adaptive behavior criteria. Seven attention tests, including measures of focused and sustained attention and working memory, together accounted for 26% of the variance in the SIB–R overall score. The correlation continued to be significant even after controlling for general intellectual functioning ($R^2 = .43$, $p < .01$). Attention tests correlated best with SIB–R clusters that involved goal directed behavior and manipulation of information. They did not correlate well with routinized behaviors or language expression. The results suggest that even when combined with other measures of general intellectual functioning, tests of attention can provide unique information that correlates with parental reports of their child's abilities.

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N. OJEDA, P. LÓPEZ GARCIA, F. ORTUÑO SÁNCHEZ-PEDREÑO, J. ARBIZU LOSTAO, & S. CERVERA ENGUIX. Attention During Mental Representation of External Stimuli: The Role of Parietal Cortex.

The goal of this study was to examine changes in relative cerebral flood flow (relCBF) using PET during a progressively complex cognitive paradigm that included auditory attention. The experimental design included 4 conditions: rest, auditory stimulation using a series of clicks, and 2 counting tasks. RelCBF (PET ^{15}O-water) and neurocognitive performance were measured on 10 normal subjects. When subjects were required to count remembering the auditory stimulation, brain activity increased in the right dorsolateral frontal cortex (BA 44–46), anterior cingulate (BA 32), and bilateral inferior parietal cortex (BA 40). The findings obtained in this study support the implications of parietal and dorsolateral prefrontal cortex when mental counting of the frequency appearance of an external stimulus is required. In our point of view, a further extension of this study could be applied to disorders (i.e., schizophrenia, brain damage) where other simple cognitive processes have been previously proven to be diminished.

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E. CASTILLO, R. DAVIS, P. SIMOS, J. BREIER, H. ISHIBASHI, W. ZHANG, & A. PAPANICOLAOU. Dynamics of Activation in Medial Temporal Lobe Structures During Encoding and Recognition.

The contribution of medial temporal structures (MTL; hippocampus, dentate gyrus, subicular complex, entorhinal and parahippocampal cortex) to explicit memory has been extensively supported by experimental and clinical studies. This study examined the dynamics of medial temporal lobe activation during encoding and recognition of words and pictures. Whole-head magnetoencephalographic recordings in 13 normal subjects during 2 learning/recognition tasks using words and pictures were modeled to estimate the intracranial sources of activity. Spatiotemporal profiles of activation showed engagement of medial temporal areas both during encoding and recognition of words and pictures with a significant intervention of the left hemisphere for almost all the participants (12/13) during word processing. The temporal analysis showed a differential temporal pattern of activation in the MTL for encoding and recognition processes and different laterality effects were reported for words and pictures. These findings provide novel information that helps us to understand the temporal pattern of activation of the MTL during the encoding and recognition of different stimuli, and the relative contribution of the left and right medial temporal structures during processing of different stimuli.

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M. FERNANDES, P. DAVIDSON, E. GLISKY, & M. MOSCOVITCH. Contribution of Frontal and Temporal Lobes to Divided Attention Effects at Retrieval.

Previous research has shown that divided attention (DA) disrupts free recall of words more when the distracting task also involves words rather than nonverbal material. This study examines the contribution of the frontal and temporal lobes to interference effects on memory produced from DA during retrieval. Elderly participants were divided pre-experimentally into 4 groups, determined by their scores on composite measures of frontal and temporal lobe function, derived from neuropsychological testing. Participants studied a list of random words under full attention, and recalled them while performing either an animacy decision task to words or an odd-digit identification task to numbers. Large interference effects on memory were produced by the animacy, but not the odd-digit distracting task. While those with poor temporal lobe function recalled fewer words, the pattern and size of interference effects under DA conditions did not differ from the other groups. Similarly, the level of frontal lobe function did not change the pattern or magnitude of interference. These findings support the component-process model of memory, which suggests that retrieval is largely disrupted only when there is competition for a common representational system. These results do not support the hypothesis that effects of divided attention at retrieval are due to a reduction in general processing resources, attentional capacity, or competition for memory structures in the temporal lobe.

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K. MUNIZ, A.M. BARRETT, P. ESLINGER, K. HANSELL, & K.M. HEILMAN. Unawareness of Partners' Abilities in Aged Subjects.

Unawareness of cognitive deficits (anosognosia) is extremely disabling to people with dementia. Anosognosia is often studied by comparing subjects' awareness of deficits with that of their caregivers. We wished to learn whether normal aged people could predict their partners' scores on cognitive tests. Using Likert scales, 15 participants (M age = 74.93 years) rated their partners' naming, visuospatial ability, memory, praxis, attention, motivation, mood, and vision. Participants then observed their partners completing standard testing (Boston Naming Test, Judgment of Line Orientation, Hopkins Verbal Learning Test, Florida Apraxia Battery, Geriatric Depression Scale, and near card visual acuity), before again rating performance. We calculated an awareness ratio (AR) in each domain where $AR = (E-P)/(E+P)$ E = participant performance estimate and P = partner's actual performance. Accurately estimating a partner's score yields AR = 0. Overestimating results in a positive AR; a negative AR indicates underestimation. Participants accurately estimated their partners' performance on memory, visuospatial, motivation, and mood tests. They overestimated naming ability (AR = 0.05, $p = 0.039$), praxis (AR = 0.10, $p = 0.009$), and vision (AR = 0.23, $p = 0.003$), but underestimated attention (AR = −0.12, $p = 0.03$). Post-testing, participants estimated partners' attention more accurately, but still overestimated naming, praxis, and vision. Why participants made these estimation errors is unknown. However, participants may have assumed that continuous processing (attention) and storing new information (memory) were more likely to be impaired in their aging partners than activating stored representations (praxis, naming).

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N. VALENZA, R. PTAK, & A. SCHNIDER. Top-Down Grouping Without Perceptual Grouping in a Patient with Extinction.

Extinction in neglect patients is characterized by a failure to explicitly detect a contralesional stimulus when presented together with an ipsilesional competing stimulus, although unilateral contralesional stimuli can be perceived when presented alone. Recent studies demonstrated that extinction might be modulated by perceptual factors such as connectedness or collinearity (bottom-up grouping). High-level factors such as grouping into a familiar configuration may also reduce extinction (top-down group-

ing). These kinds of grouping have not yet been examined in the same patient. Here, we present a patient with pure right-sided neglect and severe extinction who detected contralesional targets (circles) significantly better when they were embedded in a familiar form (a pair of glasses or a face) than in a non-grouping condition (Experiments 1 & 2). In contrast to these top-down grouping effects, contralesional stimulus detection was not significantly improved when the stimulus was grouped by collinearity with the ipsilesional stimulus (Experiment 3) or when both were embedded in a nonfamiliar form (Experiment 4). Against findings described in the literature, contralesional stimulus detection in conditions of grouping by connectedness (Experiment 5) was significantly worse than detection of ungrouped items. These results show that bottom-up and top-down grouping may be dissociated in one and the same patient.
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R. PTAK, N. VALENZA, & A. SCHNIDER. Impaired Feature Binding of Contralesional Stimuli in a Neglect Patient.
Patients with visual extinction fail to report a contralesional stimulus when it is presented simultaneously with an ipsilesional stimulus. Recent studies suggest that in spite of the absence of conscious perception, considerable knowledge may be extracted of extinguished stimuli. The present study examined what properties of extinguished stimuli are accessible to consciousness of a patient (GA) with severe left neglect. The stimuli differed on 2 dimensions, form and color. Experiment 1 revealed severe left extinction (90% left stimuli detected in unilateral, but only 10% in bilateral displays). Even if told that there were always 2 stimuli present, GA was not able to recognize the form or color of the contralesional stimulus (Experiment 2). In Experiment 3, GA was told that he would be asked after stimulus presentation a specific feature (e.g., form) of one of the 2 stimuli. On most trials, he had to indicate the specified (valid) feature; however, on some trials the unspecified (invalid) feature was requested. GA recognized the valid feature of the contralesional stimulus significantly better than the invalid feature (72% *vs.* 47%). In Experiment 4 GA had longer latencies when searching for a feature conjunction than for a single feature of contralesional stimuli. These results suggest that GA is not able to identify single features or feature conjunctions of contralesional stimuli in bilateral displays, but that top-down processes can modulate his identification of single features.
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C.A. PIERCE, G. JEWELL, & M. MENNEMEIER. Are Psychophysical Functions Derived From Line Bisection Reliable?
Power functions are used to characterize both normal perception and altered perception among patients with neglect, yet the reliability of these functions is rarely examined. The present study examined 2-week, test-retest reliability for power functions derived from line bisection data among 58 normal, young and old, male and female subjects. Power function exponents and constants were, at best, moderately reliable over time. Reliability coefficients varied by age and gender; being highly significant for young men, marginally significant for older men, and nonsignificant for women. The size of the exponent decreased significantly upon retesting, primarily among older men. Age and gender effects in this study parallel those in the literature on pseudoneglect and they may reflect hemispheric differences in visuo-spatial processing.
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J. KLAGES, J. INGLES, & G. ESKES. A Case Study of the Effects of Neglect on Reading.
NF is a 66-year-old white male who had a right hemisphere infarct affecting the basal ganglia, posterior temporal, and occipital lobes, associated with impaired left-sided sensory and motor function and left hemi-spatial neglect. Clinical neuropsychological screening with the Cognistat on admission to a rehabilitation service showed no evidence of dementia and severe left-sided neglect on the Behavioural Inattention Test. Further testing of his neglect revealed evidence for neglect based on sensory/perceptual rather than motor mechanisms, and object-centered left-sided errors or omissions, suggesting a representational deficit. Neglect dyslexia was also seen in his reading errors and omissions on the left side of single words. Interestingly, his reading errors were significantly higher for regular words (13/30) and nonwords (14/30), than for matched irregular words (2/30), suggesting different forms of lexical representations and/or processing as revealed by the differential effects of neglect. To our knowledge, this difference between regular and irregular words has not been previously reported in the literature and will be valuable in developing a fuller understanding of normal reading processes as well as lexical neglect.
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Poster Session 4/8:00–10:45 a.m.

EXECUTIVE FUNCTION

E. MITSIS, M. SANO, A. CHEUNG, A. BAUZO, & J. HALPERIN. The Effect of Age and Mild Cognitive Impairment on Executive Function.
While the memory changes in age and Alzheimer's disease (AD) have been well documented, less is known about executive function (EF) deficits in normal aging or in individuals with memory problems. EF includes processes such as working memory, verbal fluency, planning, self-regulation, and shifting set. Some, but not all, of these processes may be effected by aging or disease processes. Although EF deficits have been reported in AD, little is known regarding the prodromal phase commonly referred to as mild cognitive impairment (MCI). The present study examined EF and aging. Subjects were 68 college students (<54 years old), 56 elderly adults (>55 years), and 28 adults with MCI (>55 years). An EF battery consisting of the Wisconsin Card Sorting Test, Stroop, Trails A & B, Category and Verbal Fluency, Continuous Performance Test, Competing Motors Program, Tower of London, and WAIS–III Letter-Number Sequencing and Digit Span subtests was administered. Multiple linear regression was performed for each EF measure to examine effects of age and MCI, controlling for education, IQ, and gender. Age and IQ effects were observed on most EF measures, with poorest performance on timed tasks. MCI effects were observed on tests of working memory and category fluency. When IQ was removed from the regression model, additional MCI effects were observed on verbal fluency and shifting sets. Longitudinal analysis are needed to determine the order of emergence of EF deficits in aging and MCI.
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P. O'CONNELL. The Effect of Word Reading Ability on the Validity of Stroop Interference Scores.
The Stroop test, conceptualized to assess response inhibition or selective attention, is widely used in the examination of executive functions. The task requires inhibition of a dominant response, word reading, in favor of executing a less practiced response, color naming. However, the validity of the Stroop interference effect depends on the automatized nature of word reading, which is assumed in an adult population. This study examined the validity of the Stroop effect in a nonclinical sample. Two hundred undergraduate students, 100 male, 100 female, (*M* age = 21.47, range 17–50) were administered a 2-hr battery of tests as part of a study of executive functions. Subjects were divided into 3 groups based on their performance on the Stroop. Participants whose Stroop performance was below average demonstrated significantly poorer performance on their ability to rapidly name colors, letters, numbers, and objects (RAN tasks) than participants whose Stroop scores fell in the average or above average

range. The RAN performance of the average and above average groups did not differ. However, when the Stroop interference scores were covaried with scores from a task of rapidly reading color names, differences in RAN performance were no longer significant. No differences across the 3 groups were observed on measures of verbal fluency and verbal flexibility. These results underscore the multidimensional nature of the Stroop and suggest that interpretation of the interference scores should be made cautiously and only in conjunction with a thorough assessment of verbal abilities.

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G. GIOIA & P. ISQUITH. The Two Faces of Monitor: Thy Self and Thy Task.

Monitoring of one's behavior and performance is a subdomain described in the set of regulatory capacities known as the executive functions. Monitoring ensures that one remains on the intended goal-oriented path. We hypothesized that monitoring one's own *social behavior* and *problem-solving* are distinct, though related, subdomains. These 2 types of monitoring behaviors were examined *via* the Behavior Rating Inventory of Executive Functions (BRIEF). The task-monitoring portion of the BRIEF Monitor Scale assesses whether a child evaluates his own task performance to ensure accuracy or appropriate attainment of a goal. The self-monitoring portion of the scale evaluates whether a child tracks the effect his behavior has on others. We examined item subsets within the BRIEF Monitor Scale for these 2 subtypes to determine whether specific subdomains of monitoring were supported. The reliability and construct validity of the 4-item task-monitoring subscale and the 4- (parent) or 6- (teacher) item self-monitoring subscales were examined using the parent (n = 1419) and teacher (n = 720) normative samples of the BRIEF. Despite the small number of items, overall internal consistency was reasonable (Parent Self-Monitor, α = .82, Task α = 78; Teacher Self-Monitor α = 88, Task α = 79). Correlation between the 2 subscales was only moderate (Parent r = .47, Teacher r = .54). Principal factor analysis of the 2 Monitor subscales with the remaining 7 BRIEF scales for the Parent and Teacher Forms found unique loadings for each: Self-Monitoring loaded strongly on the Behavioral Regulation factor; Task-Monitoring loaded strongly on the Metacognition factor. These findings support a dual-function definition of monitoring and inform clinical interpretation and intervention.

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A. BAGLEY, M. WELSH, P. RETZLAFF, C. WOLF, & E. BRYAN. Towers of Hanoi and London: Contribution of Procedural Learning and Inhibition.

The Tower of Hanoi and Tower of London tasks are often assumed to be isomorphic executive function tasks assessing skills mediated by the prefrontal cortex. The moderate correlation between performances on the 2 tasks suggests that they may be assessing somewhat different cognitive processes. Given that some researchers utilize the TOH as a measure of procedural learning, the contribution of this skill, as well as inhibition, to performance on both tower tasks was examined. Forty-eight college undergraduates (M age = 19 years) were administered a battery of tests: TOH–R, TOL–R, 2 procedural learning tasks (Mirror Tracing, Rotary Pursuit), and 2 inhibition tasks (Stroop, Contingency Naming). The 2 tower tasks correlated moderately (r = .47), consistent with previous research in our laboratory. Analyses also demonstrated that procedural learning performance, as measured by Mirror Tracing, explained a greater proportion of the variance in TOH–R scores, than in the TOL–R scores. However, inhibition task performance explained a greater proportion of the TOL–R variance, than the TOH–R variance. Unexpectedly, males outperformed females on the TOH–R and the prediction of performance by procedural learning was stronger in this group. Although these results suggest that procedural learning may underlie problem solving on the TOH–R, there remain questions regarding the construct of procedural learning itself. The 2 tasks purported to measure the construct did not correlate significantly in this study. The possibility exists that other skills tapped by the Mirror Tracing test (e.g., visual-spatial skills, motor inhibition) are mediating the correlation between this task and the TOH–R.

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C. LOCK, M. WELSH, C. ADAMS, & A. KURTZ. Tower of Hanoi: Influence of Strategy Instruction and Extended Practice on Performance.

Research in our laboratory has suggested that performance on an executive function task, the Tower of Hanoi–Revised (TOH–R), may be determined by a variety of cognitive processes, such as working memory, inhibition and procedural learning. A unique feature of the TOH task (distinguishing it from the Tower of London) is that the application of a single rule-based strategy (i.e., goal recursion) can solve any problem. The current study examined the effects of explicit goal recursion instruction on performance. Fifty-five undergraduate participants (M age = 19 years) were randomly assigned to 2 groups: Strategy Instruction (SI) and Extended Practice (EP). Both groups were given the same set of practice problems, the 22-item TOH–R, a strategy questionnaire, a working memory test, and an inductive reasoning task. The SI group also was given a detailed explanation of the goal recursion strategy. Both groups performed significantly better on the TOH–R than observed under standard conditions (Welsh & Huizinga, 2001); however, there was no significant difference between the two experimental conditions. Unexpectedly, the SI group did not show more strategy knowledge than the EP group, and knowledge was uncorrelated with performance. Working memory and inductive reasoning positively correlated with TOH–R performance in both groups. It appears that extended practice with the task allowed participants to "learn" as much as those participants provided with the goal recursion strategy; however, the lack of association with strategy knowledge begs the question of whether this learning is explicit or implicit.

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C.A. CHASE-CARMICHAEL, W.F. McKEEVER, & R. THOMAS. Factor Analysis of the Frontal Lobe Personality Scale.

The Frontal Lobe Personality Scale (FLOPS) of Paulsen et al. (1995) is a 46-item scale designed to assess 3 frontal behavioral syndromes: apathy, executive dysfunction, and disinhibition. Data regarding the question as to whether or not these 3 conceptual factors exist as empirical factors or are independent or overlapping has hereto been lacking. The present study carried out a factor analysis of the FLOPS to determine if the scale does contain the 3 proposed factors. A total of 227 undergraduate students who denied history of relevant mental or physical health problems were studied. Results indicated that significant mean sex differences were seen on 24 of the 46 FLOPS items, with the mean male scores higher than females in 23 of the 24 instances. Therefore, separate factor analyses were carried out for the 2 sexes. For both groups (145 females, 82 males) a 3-factor solution emerged and accounted for 34.0% and 37.8% of the variance, respectively. The three obtained factors were moderately related to the *a priori* scales of the FLOPS. These factors are demonstrable in the normal population.

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B. GOLDSTEIN, G. LEDAKIS, & C.L. ARMSTRONG. WCST Performance Following Low-Grade Brain Tumors.

The Wisconsin Card Sorting Test (WCST) has historically been regarded as a sensitive and specific measure of frontal lobe functioning. However, more recent lesion (Stuss et al., 2000) and physiological (Barcelo, 2001) studies have reported that the WCST does not consistently differentiate anterior from posterior damage, questioning the test's specificity to frontal functioning. We investigated the performance of patients with primary, low-grade brain tumors on the WCST. Thirty-five patients were separated

into an anterior (ANT; $n = 25$; M age = 40.32; M educ = 15.24) or posterior lesioned group (POST; $n = 10$; M age = 36.10; M educ = 16.30) and compared to an age and education matched group of normal controls (NC; $n = 63$; M age = 42.24; M educ = 15.68) on the number of categories achieved and the perseverative errors indices of the WCST. We hypothesized that the performances by the patient groups on both indices would be equally impaired. There were no significant differences between the ANT and POST groups on either index, however, nor were the patient groups significantly different from the NC group. Individual analyses showed that only 28% and 24% of the ANT and 20% and 0% of the POST group were impaired on the categories achieved and perseverative error indices, respectively. The negative findings suggest that the WCST's categories achieved and perservative errors indices are not sensitive enough measures to differentiate anterior and posterior patient performance. In fact, neither WCST index proved sensitive enough to differentiate patients from normal controls. Alternative explanations for these negative results include the patient's high level of education or that the nonaggressive nature of these tumors results in only subtle neuropsychological changes not measurable by the WCST.

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P. CIRINO. Relation of Working Memory and Inhibition to Executive Function and Academic Skill.

Working memory (WM), inhibition, and executive functions (EF) are not often assessed independently; similarities and differences among these constructs are therefore difficult to detect. For WM tasks, it is unclear whether content specificity, or the separation of tasks by memory demand, is necessary for predictive ability in outcome measures. In this study, WM and Inhibition tasks were designed to isolate memory demand (STM, WM, WM+Inhibition) and content (Verbal, Math, Spatial), yielding 9 tasks in all. The relation of these tasks to commonly used measures of EF (Stroop, Verbal Fluency, Trailmaking Test), nonverbal intellectual functioning (WASI Block Design), and reading and math (WJ–R Tests of Achievement) was examined in 55 undergraduates (M age = 19.5, SD = 1.5). Results revealed differences on experimental measures by memory demand regardless of content; STM appeared easier than WM tasks (all comparisons, $p < .0001$), which in turn appeared easier than WM+ Inhibition tasks (all comparison, $p < .0001$). Spatial tasks appeared easier than Verbal and Math tasks at each level of memory demand (range $p <$ .02 to .0001). Spatial tasks were predictive of performance on Trailmaking Test ($p < .02$), intellectual functioning ($p < .003$), and math achievement ($p < .001$), even with Verbal and Math tasks in the same regression equations. Verbal and Math tasks were generally not predictive of outcome measures when Spatial tasks were also included. These results stress the need to consider both content and memory demand when attempting to measure WM skills and predict important and ecologically valid outcomes.

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D. J. SLICK, E.M.S. SHERMAN, M.B. CONNOLLY, & K. EYRL. Correlates of Parent Ratings of Executive Functions in Children With Intractable Epilepsy.

The Behavioral Rating Inventory of Executive Function (BRIEF) is a recently developed instrument for obtaining ratings of child and adolescent behaviors within 8 domains of executive function (e.g., self-monitoring). Few clinical studies have been published on the measure. Preliminary clinical data on the BRIEF are presented from a sample of 21 children and adolescents with intractable epilepsy who were seen for neuropsychological assessment. In all cases, a parent completed the BRIEF. Overall, the sample was rated as having significantly more executive function problems than normal children. The prevalence of clinical elevations across BRIEF scales ranged from 10–48% of the sample. Thirty-eight percent of the sample had 4 or more clinically elevated scales. However, one third of the sample had no clinically elevated scales. In general, BRIEF scores were moderately to highly intercorrelated. Scores from the BRIEF were also moderately to highly correlated with scores from other parent rating scales of attention, hyperactivity, and social skills. Relations between clinical scales from the BRIEF and scores from a number of objective measures of executive functions (e.g., WCST-64) were only partially consistent and some expected relations were not seen. The results of this study suggest that a substantial proportion of children with intractable epilepsy display significant executive function deficits in daily life, but that these deficits—at least as rated by parents—are not consistently related to performance on laboratory measures of executive function.

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M. RENAUD, M. LEVESQUE, M. J. CHOUINARD, S. CHOUINARD, & F. RICHER. Developmental Increase in the Attentional Control of Movements from 5 to 18 Years.

We have previously found that the precision of reaching movements in unpracticed contexts such as mirror-inverted feedback is sensitive to frontal and striatal damage (Richer et al., 1999, 2001). The present study examined the development of this ability. Sixty children and adolescents (5–18 yrs) with no history of neurological or psychological problems performed 2D arm movements to reach peripheral targets on a graphics tablet under indirect visual control from a large cursor on a monitor. Movements were performed in either the natural visuomotor mapping (16 trials) or in a mirror-inverted mapping (32 trials). The results show that precision measured by trajectory length improved nonlinearly, reaching adult levels around 16 years. This developmental curve is similar to that observed in measures of executive control. This suggests that maturation of cognitive control processes can be indexed by simple reliable measures of voluntary programming processes which involve little working memory.

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C. BOULET, M. LÉVESQUE, S. CHOUINARD, P. LESPÉRANCE, & F. RICHER. Early Huntington's Disease Affects Visuomotor Control in High-Precision Contexts.

Huntington's disease (HD) affects the execution of movements in novel conditions such as a transformed visual feedback, suggesting a deficit in the attentional control of unpracticed movements (Richer et al., 2001). However, it is still unclear whether this problem only appears in conditions involving movements which must override automatic responses or whether it represents a general problem with the attentional control of movements. To test this question, we compared the performance of 10 early HD patients and 10 aged-matched controls in unpracticed movements and in simple well-practiced drawing movements requiring different levels of precision control. Subjects had to draw circles of 10 cm in diameter on a graphics tablet as fast as possible during 1 minute while monitoring their movements on a screen. Three visuomotor control conditions were examined: (1) freehand drawing, (2) drawing within visual boundaries separated by 15 mm, or (3) drawing within boundaries separated by 2.5 mm. HD patients showed no choreic movements during drawing and were not significantly slower than controls. However, in the 2.5-mm boundary condition, they produced more irregular trajectories mostly linked to more frequent inappropriate corrections ($p = 0.005$). Controls showed little change in precision between conditions. This problem was associated with attention and executive control problems on other tasks. The data indicate that HD patients have a general problem with the attentional control of simple visually-guided movements, even in more natural conditions involving well-practiced movements.

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K. BURTON, S. RAPCSAK, E. GLISKY, & P. DAVIDSON. Problem Solving in Individuals with Frontal Lobe Damage Using the "20 Questions" Game.

The aim of the present study was to investigate the strategic problem solving abilities of individuals with frontal lobe damage (FL). Six indi-

viduals with frontal lobe damage and 8 age- and education-matched control subjects were asked to identify an object the experimenter was thinking of using 20 or fewer questions that called for a yes or no answer. Subjects were given 10 items to identify in this fashion. Compared to controls, FL subjects successfully identified significantly fewer items, asked significantly more questions, were significantly less able to narrow the field of choices down to the category to which the item belonged, and made significantly more "guesses"—defined as "Is it X?"-type questions which were not informed by previously asked questions. To further investigate whether FL subjects' performances would be aided by providing them with a built-in search strategy, subjects were asked to identify a particular playing card in 20 questions or less. All FL subjects were able to successfully identify the playing card, but they required significantly more questions than controls to do so. These results suggest that FL subjects have difficulty with goal-oriented strategic problem solving, and this difficulty is only partially ameliorated by providing them with clues.

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R. McINERNEY & K. KERNS. Development of a New Measure of Spatial Working Memory for Children.

Working memory (WM) is an important neuropsychological construct, but there are few existing measures that are developmentally appropriate for young children. Many tasks depend heavily on functions other than WM (e.g., knowledge of numerical relationships) or on skills that younger children may be just learning; such tasks may assess a range of abilities other than WM. We sought to create a new measure of WM suitable for use in a broader age range of children. In the Spatial Ordering Game, children were read aloud progressively longer lists of common objects (e.g., pencil, mountain, train), and asked to repeat them back to the experimenter in order of size from smallest to largest. A sample of 30 children with ADHD and 30 matched control children (ages 6–13) completed this task in addition to 3 established measures of working memory, including: (1) Digit Span Backward (WISC–III); (2) the Children's Paced Auditory Serial Addition Task (CHIPASAT); and (3) the Sentence Span Measure (Swanson et al., 1989; based on a task by Daneman & Carpenter, 1980). The groups differed significantly on the Spatial Ordering Game, with an effect size second only to that of the CHIPASAT. The Spatial Ordering Game correlated significantly with the 3 other WM tasks and, as expected, scores improved with age. On a subsequent factor analysis of all 4 WM tasks, the Spatial Ordering Game showed the highest loading on a 1 factor solution. We discuss the relevance of these results in the context of ADHD and the development of WM.

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S. NICHOLS, D. TRAUNER, G. GIOIA, J. CLARK, S. WALLER, & K. VALENZUELA. Parent Ratings of Executive Functioning in School-Age Children Following Early Brain Injury.

The effect of childhood brain damage or disease on the development of executive functioning is an increasingly active area of investigation in neuropsychology. Laboratory studies of children with early, focal brain damage have shown long-lasting problems with some aspects of executive functioning, including planning, set-shifting, and working memory, but not with others, such as response inhibition. This study extended those findings to everyday behaviors related to executive functioning by using parent ratings. Participants included 15 children (age range 8–14; 10 males) with unilateral, focal, pre- or perinatally acquired brain lesions (FL group) and 90 control children, group-matched for age and socioeconomic status. One parent of each participant completed the Behavior Rating Inventory of Executive Function (BRIEF), a standardized questionnaire with 8 scales that comprise 2 summary Index scores, Behavioral Regulation and Metacognition. The FL group received significantly higher *t* scores, indicating greater problems, on the Metacognition Index and 2 of its components, Working Memory and Plan/Organize. Scores were largely within the normal range, although 3 children in the FL group with right frontal white matter lesions had elevated Behavioral Regulation and Metacognition Index *t* scores. Scores on the Metacognition Index were significantly related to Vineland Socialization scores. The relationship of BRIEF scores to lesion location, other measures of everyday functioning, and performance on laboratory tasks will be discussed. In summary, parent ratings show ongoing deficits in executive functioning in some children with early, focal brain injury and, like laboratory measures, suggest a dissociation between behavioral regulation and metacognitive aspects of executive functioning.

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O. MICKIEWICZ, P. ANDERSON, V. ANDERSON, R. JACOBS & E. NORTHAM. Measuring Behavioral Aspects of Executive Function in Children: Correlation's With Neuropsychological Test Measures.

This study addressed the clinical and construct validity of the Behavioral Rating Inventory of Executive Function (BRIEF), a questionnaire designed to tap behavioral aspects of executive functions in children. BRIEF profiles in early treated phenylketonuria (PKU) ($n = 44$), early treated hydrocephalus ($n = 45$), frontal focal lesions ($n = 20$), and controls ($n = 80$) were examined. Clinical validity was supported through significant between-group comparisons, especially between the frontal focal lesion group and other groups. To examine construct validity, raw scores on cognitive executive function measures including the Contingency Naming Test (CNT), Rey Complex Figure (RCF), and Verbal Fluency test (VFT), were correlated with BRIEF scale scores. No correlation was found, indicating cognitive and behavioral measures tap different constructs within the executive function domain. A dissociation was found between behavioral and cognitive impairments between the frontal as opposed to PKU and hydrocephalus groups. This is discussed in relation to underlying pathology, the cognitive measures used, and possible limitations in the BRIEF's usefulness for measuring behavioral executive dysfunction in groups only mildly affected by neurological compromise.

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S. AMANO, D. SULTZER, J. DUNKIN, C. HINKIN, S. CHEN, & M. MAHLER. Executive Dysfunction as a Predictor of Functional Impairment and Neuropsychiatric Disturbance in Patients with Vascular Dementia.

Previous research has shown that it is not the presence of a dementia syndrome but functional disability and/or neuropsychiatric symptoms that are the key determinants for nursing home placement. Both functional impairment and neuropsychiatric disturbance have been associated with executive dysfunction. However, very few studies have examined whether performance on neuropsychological measures of executive functioning is an actual predictor of functional status and neuropsychiatric symptoms. This present study examined the relationship between neuropsychological measures of executive functioning and functional status, as measured by the Blessed Dementia Scale–Activities Subscale, and neuropsychiatric symptoms as measured by the Neurobehavioral Rating Scale–Total Score (NRS), in 14 patients with vascular dementia (VAD). It was hypothesized that measures of executive functioning would predict functional ability and neuropsychiatric symptoms beyond that of global cognitive functioning (MMSE $M = 21$), depression (Hamilton Depression Scale), age, IQ, and education. Multiple regression analysis revealed that MMSE contributed to 59% of the variance in predicting functional status, but that Wisconsin categories (WCST) accounted for an additional 20% of the variance. Similar analyses with the NRS revealed that neuropsychological measures of executive functioning were not significant predictors of neuropsychiatric symptoms after partialing out MMSE and Ham-D scores. These results suggest that the ability to modify behavior based on feedback from the environment, as measured by the WCST, may be an important predictor in functional independence and that executive dysfunction may make a con-

tribution distinct from gross cognitive functioning in determining one's functional status. However, executive deficits do not appear to make any unique contribution to the prediction of neuropsychiatric symptoms in VAD.

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J. COSCIA, M.D. RIS, B. HUTH, & D. GILBERT. Inhibitory Control and Tourette's Syndrome.

Tourette's syndrome (TS) has been hypothesized to stem from impaired inhibitory control. A key question in the cognitive literature on TS is whether inhibition is a core deficit in TS *per se* or whether it is specific to comorbid conditions of ADHD and OCD. Parents of 68 children with TS completed ratings of their child's behaviors (M age = 12). Sixty-two percent ($n = 42$) of the sample had comorbid psychiatric conditions (i.e., ADHD or OCD). Children with TS alone ($n = 26$) were compared to children with comorbid TS ($n = 42$) across the Inhibit Subscale of the Behavioral Rating Inventory of Executive Functioning (BRIEF) and the Behavioral Symptoms Index of the Behavioral Assessment Scale for Children (BASC). Repeated measures analysis of variance revealed significant main and interaction effects. Children with comorbid TS scored significantly higher than the TS alone group across the 2 measures ($p < .001$). Children were rated significantly higher on the Inhibit Subscale of the BRIEF *versus* the Behavioral Symptoms Index of the BASC ($p = .005$). Children with TS alone scored significantly higher on the Inhibit Subscale of the BRIEF than on the Behavioral Symptoms Index of the BASC, whereas children with comorbid TS were relatively consistent across these 2 measures ($p = .002$). Furthermore, correlation between the Inhibit Subscale and the Behavioral Symptoms Index was statistically significant ($r = .76$; $p < .001$). This study suggests that children with TS alone exhibit problems with inhibition, and problems worsen as a function of comorbid symptoms and symptom severity.

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Y. SUCHY & D. OSMON. Local-Global Reaction Time Tasks Show Executive Deficits in Learning-Disabled Adults.

Individuals with learning disabilities (LD) are generally characterized by focal dysfunction in the left posterior brain (Satz, 1991), resulting in reading, written language, and math problems. Anterior dysfunction is typically not reported, although executive deficits have been hypothesized to underlie continuing learning problems into adulthood (Denkla, 1993). The present study examined executive performance in 44 adult college students referred for LD assessment (LDR) and 54 college student volunteers (SV) with no learning complaints. Because traditional executive measures are known to have limited sensitivity to subtle dysfunction, we used 3 reaction time tasks, all with identical local–global stimuli. The tasks were designed to place progressively increasing demands on executive abilities: (#1) perceptual divided attention task, (#2) conceptual divided attention task, and (#3) directed attentional shifting. A repeated measures factorial ANOVA yielded a main effect of Task, with progressively longer RTs from #1 to #2 to #3, suggesting increasing processing demands despite identical stimuli [$F(2,176) = 130.21$, $p = .000$]. A 3-way interaction between Task, Global–Local trials, and Group [$F(1,88) = 14.19$, $p = .000$] demonstrated that (a) on the Global trials, LDR had longer RTs than SV only on Tasks #2 and #3; and (b) on the Local trials, LDR performed more poorly than SV on all 3 tasks. The results are consistent with well-recognized left posterior deficits in LD individuals (i.e., Local trials on Task #1, which was primarily perceptual). Additionally, results support Denkla's hypothesis of executive dysfunction in adult LD by suggesting weaknesses in conceptual abilities and attentional shifting.

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M.C. McKINNON & M. MOSCOVITCH. "Theory of Mind" Deficits in Older Adults.

"Theory of mind" has been widely studied as a cognitive mechanism thought to underlie our ability to understand and predict the behavior of others. Several neuroimaging studies have addressed this issue, finding evidence of a dedicated frontal lobe circuit underlying performance on theory-of-mind tasks; recent lesion work provides confirmatory support for this hypothesis. Nonetheless, the results of many of these studies are confounded by the authors' failure to control for the number of relations held in mind across theory-of-mind and non-theory-of-mind tasks. Specifically, whereas theory-of-mind tasks typically require participants to amalgamate 2 perspectives simultaneously (the person's own and that of another), non-theory-of-mind tasks often require single perspective taking only. We examined this issue in a group of older adults who were required to read complex social scenarios. We chose to study older adults because of their purported frontal dysfunction. When questions took the form of "What does A think B thinks/feels about X", older adults were impaired relative to younger controls. Older adults experienced no such difficulties, however, when questions required single perspective taking only (i.e., "What does A think/feel about X"). In a subsequent experiment, older and younger adults completed a perspective-taking task that required them to compare their own perspective with that of another person. Older adults were unable to identify the ambiguities in a set of instructions that would prevent another person from reaching a specified location on a shared map. We speculate that the frontal-lobe mediated working memory demands of dual perspective-taking tasks may have contributed to older adults' poor performance and may explain why the frontal lobes are implicated in theory-of-mind tasks.

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M.C. McKINNON & M. MOSCOVITCH. Performance Deficits in Older Adults on Tests of Logic Involving Social Reasoning.

Logical reasoning on Wason-type selection tasks is improved if the problem is presented as one involving a social contract or a hazardous situation. These findings have been interpreted as evidence for a dedicated cognitive mechanism involving social reasoning. We compared the performance of older and younger adults on such tasks to see if putative deficits in working memory and frontal functions in older adults would contribute to task deficits. Participants read brief scenarios and identified which of 4 hypothetical cards were necessary to confirm a statement in the scenario. When performance on a social contract and descriptive version of the scenarios was compared, benefits of social reasoning were greatly attenuated in older adults; younger adults also outperformed older adults in both conditions. When we presented participants with scenarios that contained bilateral (e.g., employer *vs.* employee) cheating options, older, but not younger, participants failed to shift perspectives and identify correctly those cards required to identify potential cheaters from differing perspectives. A similar pattern of performance was observed on a reasoning task involving a hazardous situation; older adults *failed* to show the expected benefit of reasoning about hazardous conditions. We speculate that working memory demands may have contributed to performance decrements on this task. Declines in frontal lobe function have been linked to deficits on tasks requiring the integration of multiple pieces of information, and may have contributed to the poorer performance of older adults, even on versions of logical reasoning tasks which younger adults perform well. Alternatively, the frontal lobes may be required to represent crucial aspects of social knowledge that contribute to task performance.

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E. MARTIN, E. HERBENER, D. PITRAK, W. WEDDINGTON, N. RAINS, G. NUNNALLY, B. BUICAN, & A. BECHARA. HIV and Drug Abuse Have Additive Effects on Working Memory Impairment.

In previous studies we have demonstrated working memory defects in HIV+ polydrug abusers compared with matched HIV− controls. In this

study we replicated and extended earlier findings using a computerized nonmatch to sample (DNM) task that required subjects to maintain and manipulate visual information over varying time delays. The 3 subject groups included 35 HIV+ and 14 ELISA-verified HIV− polydrug abusers (drug of choice primarily crack cocaine or heroin) and 40 HIV− controls with no history of drug abuse. All drug abusers' toxicology screens were negative for opiates, cocaine, and cannabis at testing. Both groups of drug abusers performed the DNM task significantly more poorly compared with normal controls ($p < .001$). In addition, HIV+ subjects showed significantly greater defects on the DNM compared to drug abusing controls ($p < .01$). These findings support our hypothesis that HIV and polydrug abuse both affect prefrontal-subcortical circuitry, but HIV+ drug abusers are at increased risk for defects in cognitive functions mediated by these circuits. We emphasize that all drug abusers were clean at testing and HIV+ subjects tested had no evidence of frank dementia or other neurological involvement. Defects in executive functions appear relatively early in the course of HIV disease, which has significant implications for HIV prevention, adherence, and risk reduction and should inform the development of new substance abuse treatments.

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Poster Session 4/8:00–10:45 a.m.

MEMORY

K. WOMACK, G. CRUCIAN, A. RIESTRA, & K. HEILMAN. Working Memory: Do Representations Just Fade Away or Do They Shrink?

Visual spatial working memory is thought to have a temporal limit of about 20 sec over which time the precision with which a specific location can be remembered decays in a nondirectional, nonspecific manner before being rescued by intermediate and long-term memory systems (Ploner 1998, Goldman-Rakic 1996). We studied the time decay characteristics of proprioceptive spatial working memory by asking 13 blindfolded subjects to remember the distance between their index fingers, which had been placed at either end of a line (160, 180, or 200 mm) and to reproduce this distance after either 0, 15, 30, or 45 sec. The reproduced distance was measured and a proportion of the original line was calculated. We found that the mean remembered proportional length decreased over time from 1.05 (0 sec) to 0.97 (15 sec) ($p = .005$), and from 0.97 (15 sec) to 0.91 (30 sec) ($p = .02$). The recalled length then remained relatively constant from 30 to 45 sec ($p = .410$). This demonstrates that, for proprioceptive spatial working memory, when the memory trace decays, the magnitude of the representation shrinks and does not just become imprecise in a nonspecific manner as has been suggested by other experiments involving visual spatial working memory. This difference could be modality specific or it could be secondary to a one dimensional *versus* a two dimensional stimulus. It could also be that place memories are fundamentally different than size memories regardless of dimensionality and are supported by distinct networks.

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J. VASSILEVA, S. DURGERIAN, J. VONGHER, M. FISCHER, L. CONANT, B. SALMERON, E. STEIN, R. RISINGER, & S. RAO. fMRI Study of Working Memory in Adults with Attention Deficit Hyperactivity Disorder.

ADHD persists into adulthood in 50–80% of cases. It is characterized by deficits in working memory (WM) on neuropsychological testing. We used whole-brain fMRI to examine the functional neuroanatomy associated with performance of a WM task in ADHD adults and controls. Eight ADHD males (ages 23–30) and 8 demographically-matched healthy males were recruited from a 2-decade long, longitudinal study of ADHD. The N-back WM task (1-, 2-, and 3-back) was administered in a block-design format, alternating with a control condition (0-back). The ADHD group was significantly less accurate than controls on the 1- and 2-back conditions. As there were no group differences in performance on the 3-back condition, this condition was used in the functional imaging analyses, to equate for task difficulty. Relative to controls, ADHD individuals exhibited significantly *greater* activation in the right inferior frontal gyrus, right parietal lobule, right and left putamen. In contrast, the controls exhibited *greater* activation in the left lingual gyrus, right precuneus, left superior parietal gyrus, and right middle occipital gyrus. These unexpected findings, i.e., ADHD subjects showing overactivity in frontostriatal circuitry, are consistent with 2 recent studies demonstrating *decreases* in prefrontal activity and *increases* in activation in visual processing areas in response to drugs (methylphenidate, physostigmine) that enhance WM performance in normals. They are also in accord with recent reports of greater magnitude of WM-related prefrontal activation in schizophrenic patients. Overall, the results suggest that in order to achieve equal task performance, ADHD subjects require increased activation of frontostriatal circuitry.

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G. SELKE, E.B. FENNELL, T. DIKEL, W. BOSCH, D. HARRELL, & D. BOWERS. Support for a Developmental Shift in Emotional Reactivity in Male Children.

Background: Over the last decade, affective modulation of the startle reflex (AMSR) has become a valuable tool for measuring emotional and physiological reactivity in normal, psychiatric, and neurologically impaired individuals. Normal adults show smaller startle reflex responses to pleasant stimuli and larger startle responses to unpleasant stimuli. The present study aimed to examine AMSR in male children age 8–12. *Methods:* Seventeen normal healthy children were presented with a 100 dB acoustic startle probe while viewing pleasant, unpleasant, and neutral picture stimuli (15 per picture category). Dependent measures included startle eyeblink magnitude and skin conductance. *Results:* For startle eyeblink reactivity, results revealed a significant interaction of Age (covariate) with linear trend over Valence Category ($p < .035$; pleasant pictures < neutral pictures < unpleasant pictures). This was explained by an "adult-like" pattern of startle eyeblink reactivity in the older males, in contrast to the younger males who failed to show an adult-like pattern. The failure of the younger males to show increased startle reactivity to unpleasant pictures was not due to a misappraisal of the emotional content of the pictures, based on verbal ratings. For skin conductance, results revealed a linear trend over Valence Category ($p = .001$), with no interaction of Age. Unpleasant pictures were associated with larger skin conductance values compared to pleasant pictures and neutral pictures. *Conclusion:* These preliminary findings suggest that an adult-like AMSR response pattern does not reliably emerge until age 11 in male children. Future research will address possible developmental changes within each gender.

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R. PTAK & A. SCHNIDER. Disorganized Memory After Right Prefrontal Injury.

The dorsolateral prefrontal cortex has been associated with specific impairments in strategic retrieval from memory, contextual memory, or self-ordered pointing. Often these deficits do not manifest themselves in daily activities of patients with chronic prefrontal cortex damage. We describe a 49-year-old woman, who 13 years after TBI with an isolated lesion of the right dorsolateral prefrontal cortex suffered from what appeared to be a severe prospective memory disorder. For example, she would present herself for a medical examination 3 hours before the rendezvous to depose her X-ray scans and then come late because she chose to clean her house shortly before the appointment. She was consistently late because she was involved in other activities at the time of her appointment, embarrassing all her friends and relatives. She tried to apply different strategies to compensate for her memory problems, such as noting on her hand or using different electronic organizers. She had several diary books at the same

time that she failed to coordinate. This disordered planning and decision-making in everyday situations did not reflect itself in the neuropsychological examination: intelligence (IQ = 100), verbal memory, executive functions, as well as other cognitive abilities were normal. The only deficit was an impaired reasoning and disordered thinking expressing itself in pragmatic language deficits. This case exemplifies the consequences of the disruption of one of the highest cognitive functions attributed to the human prefrontal lobes: the integration of behavior based on the respect of temporal contingencies.

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G.P. LEE, K. J. MEADOR, D.W. LORING, J.D. ALLISON, T.B. LAVIN, W.B. BROWN, & L.K. PAUL. Subcortical and Cortical Activation in Positive and Negative Emotions: A Functional MRI Study in Healthy Controls.

Recent research has provided a rough sketch of the neurological underpinnings of emotional processing and expression involving specialized contributions of limbic and cortical regions of the brain. Specifically, electrophysiologic, functional imaging, and Wada test data have suggested that positive, approach-related emotions are more associated with left cerebral hemisphere regions, whereas the negative, withdrawal-related emotions appear to be more aligned with right hemisphere mechanisms. These emotional-neural associations were investigated using functional magnetic resonance imaging (fMRI) in 10 healthy controls with 20 negatively- and 20 positively-valanced photographs (equated for arousal) from the International Affective Picture System in a counterbalanced order. Interspersed in the emotional photographs were 20 control photographs consisting of nonsense line drawings. Photographs were viewed within a 1.5T scanner through computerized video goggles for 6 s each. Each study included a 3D structural T1-weighted MPRAGE data set for anatomic definition. 120 echo-planar data sets were acquired for each subject. Emotional sides resulted in significantly increased blood flow bilaterally in the amygdala, caudate, cerebellum, anterior cingulate gyrus, and orbital and mesial frontal lobe. Negative emotional photographs caused greater activation of the amygdala, caudate, mesial frontal, and anterior cingulate gyrus in the right hemisphere, and positive photographs resulted in greater activation of these regions in the left hemisphere. Results are consistent with theories emphasizing the importance of amygdalar, anterior cingulate-subcortical, and orbitofrontal-subcortical circuits in emotional processing and affective experience, and with the valance model of emotion which posits lateralized specialization for positive and negative emotional experiences.

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L. PENTLAND, V. ANDERSON, D. DYE, & S. WOOD. The Nine Box Maze Test–Child Version: A Visuospatial Memory Task.

One aspect of visuospatial memory is the integration of information about "what" and "where" to form cognitive maps. These maps are then available to the individual to facilitate future navigation. The development of these spatial maps therefore represents a significant, but as yet poorly understood, milestone. Traditional neuropsychological measures have frequently been criticized as lacking sensitivity to tap these more complex visuospatial processes. Recently, Abrahams et al. (1997) developed a complex measure of visuospatial memory, the Nine Box Maze Test (NBMT), offering an alternative to standard assessment techniques. This study aimed to modify the NBMT to be suitable for use with children, and secondly to use this NBMT–Child Version (NBMT–CV) as a means of investigating the normal development of more complex visuospatial memory function. Traditional neuropsychological memory tasks were also included for comparative purposes. Sixty children aged 5–12 participated in this study. Results indicate that the NBMT–CV is an appropriate tool for children. There was evidence of development across the age range, with a spurt in abilities around age 7. Further, there was an absence of a floor and ceiling effect. This pattern of development was distinct from a flatter developmental trajectory suggested by other measures. Principal Components Analysis also reinforced that the NBMT–CV was tapping distinct skills to other measures. These results are discussed in developmental terms, as well as the issues raised for the current approach to assessment of visuospatial memory function.

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K. GARVEY & S. CHRISTMAN. Eye Movements, Hemispheric Activation, and Explicit *vs.* Implicit Memory.

Previous research (Christman & Garvey, 2000) demonstrated that alternating left-right horizontal saccadic eye movement (EMs) prior to testing enhanced the recall of explicit, but not implicit, memories; bilateral pursuit EMs had no effect on either type of memory. The authors interpreted these results as arising from the role of bilateral EMs in inducing bihemispheric activation, which in turn enhances the between-hemisphere division of labor in episodic encoding *versus* retrieval (e.g., Tulving's HERA model). The lack of effect of pursuit EMs presumably arose from the fact that pursuit EMs generate lesser cortical activation than saccadic EMs. The current study examined the effects of up-down vertical EMs (saccadic *vs.* pursuit) on explicit recognition *versus* implicit fragment completion, and found no effects of either EM type (compared to a no EM control condition) on memory performance. Given that left-right eye movements activate the contralateral hemispheres while up-down eye movements do not involve selective hemispheric activation, further support is provided for the hypothesis that bilateral EMs induce bihemispheric activation, which in turn enhances interhemispheric interaction, which in turn enhances retrieval of explicit, but not implicit, memories. Interestingly, vertical EMs did result in a more conservative response bias on the explicit memory task (i.e., mistakes tended to be misses, not false alarms), echoing a similar effect for horizontal saccadic EMs. Implications for the procedures employed in Eye Movement Desensitization and Reprocessing (EMDR) therapy and for the False Memory Syndrome are discussed.

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S. CHEN, T. HAMMEKE, S. MILLER, & J. BINDER. Temporally Graded Retrograde Amnesia After Psychomotor Status Epilepticus.

Retrograde amnesia (RA) appears to represent a functionally heterogeneous phenomenon with varying profiles of episodic and semantic memory loss, the anatomical correlates of which are not yet fully delineated. We report a case of a woman showing temporally graded retrograde amnesia in the presence of dense anterograde amnesia due to an extended interval of complex partial status epilepticus. Brain MRI FSEIR showed bilateral symmetric increased signal and swelling of the amygdala, uncus, and the full length of the hippocampi. When examined 2 weeks after injury, she was alert and had grossly intact neurologic functions. Neuropsychological evaluation revealed a dense anterograde amnesia with no recall of new information and chance recognition after a few minutes. An autobiographical memory interview showed preserved memory for childhood and early adult personal semantic memory and incidents. However, she was amnestic for personal events that occurred in the previous year, with better recall of public events (e.g., presidential election). She also showed a graded RA concerning sites of residence and a male relationship that spanned the previous 4 years. Semantic priming, as measured by a stem completion task, was within normal limits, suggesting intact implicit memory. Confrontation naming and semantic fluency were marginally impaired. Findings from this case suggest that the hippocampal complex is not only crucial for encoding and retrieving new information, but also for recalling episodic information acquired well prior to the lesion onset. In addition, the results suggested a temporal gradient in RA with damage localized to bilateral medial temporal lobes.

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H.G. BELANGER & D. BOWERS. Affective Verbal Memory Following Unilateral Temporal Lobectomy.

Research has demonstrated that temporal lobectomy patients differ from controls in memory for affective stories (Buton et al., 1999; Wechsler, 1973). Phelps et al. (1997) investigated recall for affectively valenced words and found that left temporal lobectomy patients (LTLE) and right temporal lobectomy patients (RTLE) showed enhanced recall for emotional words. Recall did not vary as a function of valence. This study did not, however, control for valence and arousal ratings and did not examine recognition. As such, in this study, we utilized a list of positively, negatively, and neutrally valenced words balanced for both valence and arousal ratings (Bradley et al., 1996), as well as word frequency and concreteness (Nelson et al., 1994). In a group (RTLE, LTLE, Control) × Arousal (High, Low) × Valence (Positive, Negative, Neutral) ANOVA, we found that control subjects ($N = 5$) recalled significantly more words overall than RTLE ($N = 5$) and LTLE ($N = 5$) patients ($F = 4.52$, $p < .05$). In general, more high arousal words were remembered by all subjects if they were negative in valence ($F = 7.47$, $p < .01$). No other interactions were significant. For recognition data, there was a significant interaction between group and arousal ($F = 4.08$, $p < .05$) such that LTLEs made more errors on high arousal words. Arousal is an important variable to include.

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S. HEPWORTH, M. AZIZ, & J. ROVET. Development of Working Memory in Childhood.

There is general consensus that multiple memory systems exist within the human brain. Although working memory has been argued as a frontal lobe system, the operational definition and specific regions of the frontal lobes have been debated. Jonides (2000) defined working memory as the ability to keep a limited amount of information accessible for a short period of time while consistently updating for an on-going task. To investigate this system, an item recognition task was developed that required the participant to retain and update information on each trial (i.e., interference trials were included to ensure that the information was updated). This task was used in neuroimaging studies to compare younger *versus* older adults, whose working memory is believed to deteriorate with age. Although both groups engaged similar areas of the posterior cortex during this task, different circuits within the frontal lobe were activated. Because working memory is thought to undergo significant development during childhood, we wished to investigate whether an item recognition task could serve to differentiate children between 7 and 12 years old. A total of 26 control children were administered an item recognition task as part of a larger study investigating working memory in clinical pediatric groups. Results revealed poorer performance by the 7–8 and 9–10 year-olds compared to the 11–12 year-olds on the high interference trials only. These results not only demonstrate the development of working memory during later childhood but also provide a comparison for clinical pediatric populations who may have working memory deficits.

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D. TSAKANIKAS, H. GOMES, & L. RAVDIN. Education Effects on Verbal List Learning Strategies of Healthy Older Adults.

Highly educated older adults perform better on verbal memory measures than those with less education. These differences have been attributed to greater cognitive reserve. Education may be associated with greater use of effective learning strategies, which could result in better performance on formal memory tests. Forty-five community dwelling older adults ($M_{age} = 75.2$, $SD = 5.1$) in self-reported good health underwent a battery of neuropsychological tests as part of a larger study on normal aging. Participants were classified as having either high education (HE; >12 years, $M = 16.7$, $N = 24$) or low education (LE; ≤12 years, $M = 11.9$, $N = 21$). These groups differed significantly on educational attainment ($t = -10.27$, $p \leq .01$). Semantic and serial clustering scores were calculated based on delayed free recall of a 12-item list. ANCOVA, with IQ and gender as covariates, revealed that the HE group outperformed the LE group on recall ($F = 3.93$, $p = .05$). Both groups utilized more semantic relative to serial clustering (both $p < .01$), however this difference was significantly greater for the HE group ($t = -3.27$, $p < .01$). Semantic clustering was associated with better recall ($r = .81$, $p < .01$). Women outperformed men on recall ($F = 7.15$, $p = .01$). LE women used more semantic clustering than LE men ($t = -2.14$, $p = .05$) and outperformed LE men on recall ($t = -2.73$, $p = .01$). Thus, education is associated with increased use of efficient learning strategies resulting in improved memory performance. Given the high prevalence of memory complaints in this population, methods for improving memory performance (e.g., semantic clustering) can be recommended for those who do not spontaneously employ them.

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T. BEATTIE, F. SZELIGO, & R. McKELVEY. A Case of Epilepsy-Induced Focal Retrograde Amnesia?

This paper describes a case of retrograde memory loss and partial seizures in a 74-year-old male. The patient reported gradual memory loss, particularly for events, over a preceding 2–3 year time period with intact memory for events of recent days and weeks. He also reported experiencing episodes of impaired consciousness. Results of neurodiagnostic testing were unremarkable. The episodes of impaired consciousness, diagnosed as partial seizures, were treated with anticonvulsant medication. History and testing indicated an unusual pattern of memory abilities and deficits. Results of the Autobiographical Memory Interview suggested marked deficits in autobiographical memory in the presence of intact personal semantic memory. Further testing revealed a preserved ability to learn new information. The relationship between seizure activity and memory was examined. Self-report suggested that the patient's concern about memory and the onset of the seizure activity coincided. Testing revealed that encoding and retrieval of personal episodic memories were preserved during the period after the commencement of anticonvulsant medication. Focal retrograde amnesia (FRA) is a rare memory pattern consisting of severe retrograde memory loss with intact anterograde memory abilities. FRA of an epileptic origin is proposed here and impaired consolidation *versus* retrieval failure are discussed as possible explanatory mechanisms.

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L. SILVERMAN, N. MINSHEW, & L. BENNETTO. Semantic Processing and Verbal Recall in Adults with Autism.

The present study examined semantic processing in autism through an analysis of performance on the California Verbal Learning Test (Delis et al., 1987). Forty-one adults with high-functioning autism and 41 normal controls were matched on age and Verbal IQ. Semantic processing was examined with quantitative and qualitative analyses of interference and intrusion errors on recall trials. Compared to controls, the autism group showed typical levels of proactive interference (PI), but minimal release from PI ($p < .003$). Further analyses divided the nonshared category into novel words and broadly-related words (from a superordinate category represented on List A). The overall lack of release from PI in the autism group was specific to the broadly-related category ($p < .001$), suggesting that participants with autism activated a more distributed semantic network than controls. Analyses of intrusions yielded a similar pattern. Participants with autism made more intrusions across recall trials ($p < .005$). This difference was accounted for solely by increased semantic intrusions, including words belonging to the superordinate category ($p < .02$). Finally, semantic cues improved correct recall in the autism group, but also overactivated the superordinate category, resulting in significantly more semantic intrusions ($p < .02$). These results suggest that individuals with autism do activate and use semantic information to aid recall. However, their category boundaries appear more broadly defined, resulting in atypical associations and limited constraints on response selection. These find-

ings have important implications for the treatment and education of individuals with autism.
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P. DAVIDSON, S. RAPCSAK, E. GLISKY, & M. MOSCOVITCH. Abnormal Decision-Making in Recognition and Object Identification After PFC Damage.
Two patients with right prefrontal damage (J.S. and B.W.) previously exhibited pathologically high false alarm rates on tests of facial recognition memory (Rapcsak et al., 1999). Such false facial recognition may reflect an over-reliance on familiarity and an under-utilization of strategic memory retrieval, monitoring, and decision processes for making recognition judgments. In particular, these patients seemed to base recognition decisions on insufficient information. In the present study, we explored whether their inability to use appropriate decision processes was confined to the memory domain or represented a more general impairment. Using a perceptual identification task, we compared J.S. and B.W. to a group of frontal patients who did not show abnormally high false alarm rates in recognition memory and to control subjects. Subjects attempted to identify fragmented line drawings of common objects, progressing from the most fragmented form (form 1) to the complete form (form 8). Overall, J.S. and B.W. made incorrect guesses on 100% of the objects compared to 25% by the other frontal patients and 59% by control subjects. J.S. and B.W. also produced responses at earlier levels of fragmentation (3.75) than the other patients (5.95) and the controls (4.24). These findings suggest that J.S. and B.W. have impaired decision processes that may affect not only episodic memory but also other cognitive domains. Specifically, they appear willing to make decisions based on poor quality or degraded information.
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G. QUINTIN, K.K. ZAKZANIS, & S. J. GRAHAM. Spatial Navigation in a Virtual Environment with Patients Suffering From Alzheimer's Disease.
Neuropsychology has proceeded as a science by developing tests that reduce complex behaviors to component cognitive domains. One example of these domains is visual memory, which is defined as the ability to recall and recognize previously presented visual material. An example of visual memory is remembering routes that were navigated. However, testing memory for spatial navigation has been largely neglected due to the poor ecological validity (that is, the degree of relevance to the "real" world) of available neuropsychological measures. For example, navigational memory in Alzheimer's disease is sometimes deficient at the early stages of the illness but it has been difficult to assess clinically. As such, one of the most fundamental problems facing neuropsychology is the ability to accurately measure visual memory. Accordingly, we have developed a virtual town that provides a realistic, yet controlled, testing environment. We present our results in terms of immediate and long delay route recall and recognition for healthy older adults and patients with mild probable Alzheimer's disease. This innovative behavioral test measure may have direct relevance for the study of visual memory in early AD.
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A. MARGOLIS, D. ERLANGER, H. KROGER, & A. THEODORACOPULOS. Visual-Motor Speed, Working Memory, and Inhibition: A Web-Based Analogue of the Stroop Test.
The contributions of frontally mediated behaviors to the performance of motor tasks are poorly understood (Pennington, 1996). This research examined the role of working memory and inhibition in a novel computerized test of visual-motor speed. Following Denckla's (1996) call to use a matched task comparison methodology for assessing executive functions, the test was comprised of 3 tasks that increased in complexity hierarchically. Each task had one additional cognitive demand so that performance tapped (1) pure response time, (2) response time with a working memory component, and (3) response time with a working memory component and an inhibition demand. Results indicated statistically significant differences ($p < .001$) among the 3 tasks within an individual's performance. The results replicate previous research demonstrating a between subject stimulus domain effect (Margolis, 2000) and lend further support to the view that these frontally mediated contributions to motor skill are distinct and can be measured independently.
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L. BEGLINGER, M. HAUT, & M. PARSONS. Amnesia Due to Craniopharyngioma Resection: Elucidation of Critical Structures and Pathways.
Craniopharyngioma (CP) patients typically show improvements in neuropsychological functioning following tumor resection. We present the case of a 52-year-old woman who underwent an orbitofrontal craniotomy for the removal of a CP, but sustained damage to white matter pathways resulting in a complete disconnection of the hippocampus from the basal forebrain. MRI revealed the absence of mamillary bodies, columns of the fornix, and mamillothalamic tracts. Diffusion tensor imaging was used to examine the presence or absence of critical white matter pathways. Neuropsychological evaluations were completed at 10 and 30 weeks postoperatively. At the first assessment, the patient demonstrated both retrograde and anterograde amnesia. She had no memory for a period of several months prior to the surgery and was capable of maintaining new memories for approximately 5 minutes. A neuropsychological battery revealed mildly impaired functioning on tests of visuomotor skills, language, attention, and executive functioning. Visual and verbal memory were severely impaired with flat learning curves and amnestic performance at delay. Striking perseveration was seen across tasks. At the second evaluation, the patient showed improvements in language and executive functions. However, her memory deficits remained essentially unchanged. On a word stem completion task and a frequency memory measure, the patient demonstrated preserved priming and frequency judgment, despite impaired recognition on each task. This case provides evidence for severe amnesia associated with a surgery usually considered relatively benign. The critical pathways between the basal forebrain and hippocampal formation are elucidated by extensive neuroradiological studies, including the various branchings of the fornix.
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V. HARTMAN, J. SCOTT, & S. GONTKOVSKY. Cross Validation and Discriminant Analysis of Measures of Verbal Memory.
The current study provides additional data on cross validation between measures of verbal memory from the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Randolph, 1998) and other well-established measures of verbal memory. Also, the sensitivity of the RBANS in discriminating between impaired *versus* nonimpaired individuals in a heterogeneous patient population is examined. Participants included 30 males and 29 females between 48 and 88 years of age ($M = 69.8$). The RBANS, AVLT, WMS–R, and MMSE were completed as a part of a comprehensive neurocognitive evaluation. Participants were assigned to 2 groups based upon performance on the MMSE (i.e., >23 nonimpaired, ≤23 impaired). Zero-order correlational analyses yielded significant relationships (p's $< .01$) between measures of verbal memory from the RBANS and the AVLT, WMS–R Logical Memory I and WMS–R Logical Memory II. Discriminant analysis using measures of verbal memory from the RBANS yielded an 86.4% correct classification rate, whereas the AVLT and WMS–R yielded an 81.4% correct classification rate. The findings indicate that measures of verbal memory from the RBANS are highly correlated with the AVLT and WMS–R. Further, the RBANS was better able to discriminate between impaired *versus* nonimpaired patients.

These data suggest that the RBANS provides a psychometrically sound measure of verbal memory in a heterogeneous adult patient population. Also, the RBANS appears to be more sensitive to cognitive impairment than the more well-established measures of verbal memory. The implications of these findings are discussed.
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C.B. FORTIER, J.F. DISTERHOFT, L. TANGEL, & R. McGLINCHEY-BERROTH. The Role of Prefrontal Cortex in Associative Learning.
The role of prefrontal cortex (PFC) in learning and memory has been extensively investigated (Fuster, 1988; Goldman-Rakic, 1987; and Kolb, 1984). In humans, damage to the PFC can affect short-term memory, planning, and interference control (Fuster, 1988). In primates and subprimates, PFC is intimately interconnected with the hippocampus, thus the PFC may be critical for associative learning in humans. Possible pathways required for elicitation of the conditioned response (CR) are cerebellum to PFC through the thalamus, or hippocampus to PFC (Middleton & Strick, 1994). Based on this evidence, we predicted that damage to the PFC would result in impaired acquisition in trace eyeblink conditioning relative to performance in the delay paradigm. We examined the ability of patients with a history of anterior communicating artery aneurysm or frontal hemorrhage to acquire CRs. Trace conditioning was administered prior to delay conditioning to control for transfer of learning. To date, 6 frontal patients have been tested in the trace 1000-ms paradigm and the delay 1250-ms paradigm. In the trace paradigm, the mean percentage CRs was 53, while in the delay paradigm it was 67. A one-tailed *t* test revealed a significant effect of paradigm ($p < .05$), indicating that the patients performed significantly better in delay as compared to trace conditioning, thus supporting our hypothesis. Within group heterogeneity was observed, however, it was not related to etiology or the presence of amnesia. Data collection will continue with frontal patients and normal participants. Neuroimaging studies are underway to investigate possible patterns of the lesion site and conditioning performance.
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K.K. ZAKZANIS & L. LEACH. Span of Personal and Present Existence in Dementia of the Alzheimer's Type.
Severely impaired episodic memory deprives patients with Alzheimer's disease (AD) of a sense of personal continuity in their daily lives, yet there are no tests that accurately measure this impairment. Recently, Zakzanis, Leach & Moscovitch (1999) examined the integrity of memory function in terms of temporal continuity in a way that would engage the patient in everyday behavior, such as informal conversation, but still allow memory function to be quantified. The task allowed the measurement of the duration of continuous, conscious experience of the present and was therefore termed "span of temporal continuity (STC)." Given that we were able to document static and growing STCs across 8 weeks in 2 patients with herpes simplex encephalitis (SEP) and streptococcal meningioencephalitis (SM) who presented to our memory disorder clinic with severe amnesia (static STC patients) and a growing STC in a patient recovering from an anterior communicating artery aneurysm rupture, we wanted to know whether our measure could track progressive memory loss. Accordingly, we followed a patient we believed was in the very early stages of AD to measure the change of his STC longitudinally. In terms of STC, we were able to document a progressively smaller span in which our patient experiences continuity prior to any telling neuropsychological deficits. Along with his STC, we present our neuropsychological and functional brain imaging findings over the course of the investigation.
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Poster Session 4/8:00–10:45 a.m.

EMOTION

G. CASTILLO, A. IGLESIAS, M. PÉREZ, & F. OSTROSKY-SOLIS. Electrophysiological Indexes of Emotional Judgments.
Event-related brain potentials (ERPs) in conjunction with cognitive paradigms have been used successfully to study changes in brain electrical activity produced by judgments of emotional stimuli. In the present study, a picture perception paradigm was implemented in which pleasant, neutral, and unpleasant pictures appear with equal probability in a random sequence. Pictures of the International Affective Picture System (Lang, 1999) were standardized in a Spanish-speaking population, and 210 color pictures were selected, depicting 70 unpleasant, 70 neutral, and 70 pleasant events. Fifteen normal subjects with average age of 25.5 years were registered. In all subjects emotional pictures (pleasant and unpleasant) evoked a larger Late Positive Potential (LPP) than neutral materials, mainly in parietal areas of both hemispheres; the unpleasant stimuli evoked larger LPP than pleasant ones. This data show the validity of this paradigm to obtain electrophysiological indexes of emotional judgments.
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J.C. BOROD, R.L. BLOOM, A.M. BRICKMAN, L. NAKHUTINA, & E.A. CURKO. Emotional Processing Deficits in Unilateral Brain Damage: A Literature Review.
This paper reviews neural mechanisms underlying emotional processing deficits in individuals with unilateral brain damage. The literature on hemispheric asymmetries for emotion was reviewed in terms of processing mode (perception, expression) and communication channel (facial, prosodic/intonational, lexical/verbal). Studies included individuals with right-(RBDs) or left-sided (LBDs) brain damage and healthy controls. In terms of *emotional perception*, we reviewed 22 studies for the face, 30 studies for prosody, and 16 studies for speech content. For facial perception, 91% of the studies showed selective deficits in RBDs, and 9% showed no selective deficits. For prosodic perception, 73% of the studies showed deficits in RBDs, and 27% showed no selective deficits. For lexical perception, 65% showed deficits in RBDs, 12% showed deficits in LBDs, and 23% showed no selective deficits. In terms of *emotional expression*, we reviewed 20 studies for the face, 18 studies for prosody, and 10 studies for speech content. For facial expression, 59% showed deficits in RBDs, and 41% showed no selective deficits. For prosodic expression, 84% showed deficits in RBDs, and 16% showed no selective deficits. For lexical expression, 100% showed deficits in RBDs. In summary, this review of the behavioral literature suggests a special role for the right cerebral hemisphere in emotional processing. With regard to perception, laterality findings are stronger for facial and prosodic channels than for the lexical channel. With regard to expression, findings are stronger for prosodic and lexical channels than for the facial channel. Differences in findings are considered in terms of methodological factors.
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J.C. BOROD, E. CANINO, A. GERACI, & J.M. SCHMIDT. Relations Among Channels of Posed Emotional Expression: Face, Prosody, and Speech.
This study was designed to determine whether there is a general processor or separate processors for the expression of emotion across multiple communication channels. These channels of posed emotional expression (i.e., facial, prosodic/intonational, and lexical/verbal) were studied in 52 adults. Posers included 17 subjects with right-hemisphere strokes, 17 subjects with left-hemisphere strokes, and 18 healthy controls. All groups were demographically matched, and patient groups were matched on lesion site. Measures of posed emotional expression from the New York Emotion

Battery (Borod, Welkowitz, & Obler, 1992) included facial emotional expressions, prosodically-intoned neutral-content sentences, and generated word lists for 8 emotions (3 positive and 5 negative). Expressions were evaluated for category accuracy, emotional intensity, and rater confidence by a separate set of 4 raters for each channel. Overall, interrater reliability was high: median complete agreement for accuracy = 73%, and median intraclass correlation for intensity = .85. When correlations were computed among the 3 channels for each rating parameter, across posers, facial and prosodic expression were significantly ($p \leq .01$) related to each other but not to lexical expression. Further, when correlations were computed among the 3 rating parameters for each channel, across posers, a similar pattern occurred for face and prosody [i.e., significant ($p < .001$) correlations between intensity and confidence] compared to the lexical channel [i.e., significant ($p < .001$) correlations among all parameters]. These findings for posed emotional expression are consistent with previous findings pertaining to spontaneous expression and emotional perception, and suggest a dissociation between nonverbal and verbal components of emotional processing.

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R. COMPTON, L. FISHER, L. KOENIG, R. McKEOWN, & K. MUÑOZ. Relationship Between Coping Styles and Hemispheric Asymmetry.

This investigation examined the relationship between individual differences in perceptual asymmetry and ruminative *versus* distracting coping styles. Reduced left visual field (LVF) biases have been reported in depressed individuals, and rumination is known to be a risk factor for depression, but no studies have examined whether coping styles are related to characteristic patterns of hemispheric asymmetry. In this study, 86 right-handed undergraduates (42 male, 44 female) received a sad mood induction and then completed 2 chimeric faces tasks (emotional and gender chimeras) and two measures of coping style. In the "choice task" measure of coping style, participants indicated their choice to engage in either an emotional or nonemotional card-sorting task. Participants also subsequently completed a self-report Response Styles Questionnaire (RSQ). Results revealed significant relationships between perceptual asymmetry and both measures of coping style. Preference for rumination *versus* distraction as reported on the RSQ was significantly correlated with reduced LVF biases on both chimeric faces tasks (p's $< .05$). When these relationships were examined separately by gender, the correlations were significant for females but not for males. Results suggest that in females, ruminative coping, as tapped by the RSQ, is associated with decreased right hemisphere activation, similar to patterns previously reported for depressed individuals. In contrast, data from the choice task revealed greater LVF bias on the gender chimeras in those who chose to engage in an emotional task compared to those who chose a nonemotional task ($p < .05$), suggesting that this aspect of coping style is associated with increased right hemisphere activation.

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T. FORREST, M. HALL, & D. ALLEN. Integration of Auditory and Facial Affect: An Emotional McGurk Effect?

Research investigating human emotion processing has typically studied either auditory (vocal) or visual (facial) information in isolation. However, speech perception literature supports integration of auditory and visual phonetic information. The speech perception literature also indicates that visual information can significantly alter the perception of auditory information, an effect known as the McGurk effect. This investigation hypothesized that visual and auditory emotional information are integrated in a similar manner as visual and auditory speech information, so that facial affect would significantly influence the perception of auditory emotional information. To evaluate this hypothesis, emotionally incongruent auditory-visual stimuli (e.g., a joyful voice with a sad face) were developed on a sample of 120 participants. These stimuli were then presented to 30 additional participants who categorized them according to 1 of 8 common emotions. Analysis of variance indicated significant ($p < .001$) Condition (matched visual and auditory information *vs.* mismatched visual and auditory information) by Emotion (joy *vs.* sadness) interaction. This finding suggested that emotional information from auditory and visual sources is integrated during the perception of emotion and that visual emotional information (facial affect) significantly altered the perception of auditory expressions of emotions. This integration appeared to occur in a predictable manner. To understand emotion perception in brain-damaged and nonbraindamaged populations, future studies will need to consider the interaction of auditory and visual emotional information.

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K. ALFANO & C.R. CIMINO. Enhanced and Reversed Asymmetries with Affective Primes.

Prior studies have noted the ability of positively- and negatively-valenced affective primes to enhance and even reverse, respectively, the typical LH > RH asymmetry associated with verbal tasks. However, these studies have used (neutral) primes that vary from emotional primes on both valence and stimulus type (verbal/nonverbal) making clear interpretation of the findings difficult. The objectives of this study were: (1) determine the extent to which presentation of emotional verbal stimuli alters the expected RVF > LVF asymmetry associated with a consonant trigram task, and (2) to employ a neutral/control condition differing from emotional stimuli on only one dimension (i.e., valence). Forty-four participants were presented with lateralized trigrams preceded by either positive, negative, or neutral primes and were asked to recall both the trigram and the prime. Results showed that LH trigrams were better recalled when preceded by a positive prime than either threatening or neutral primes (enhanced LH effect). However, during RH trials, trigrams preceded by threatening words were better recalled than those preceded by neutral or positive primes (reversal of LH effect). Similar results were found for the recall of the affective word primes. In summary, presentation of positive and negative primes enhanced and reversed, respectively, the typical RVF advantage for recall of consonant trigrams. These findings are not consistent with predictions from valence models, which posit that perception and appraisal of affective stimuli are mediated exclusively by the RH, suggesting that revisions of these models may be warranted.

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M.T. HEINLY, K.W. GREVE, D. ADAMS, & K. J. BIANCHINI. Emotion Processing in a Patient with a Pericallosal Artery Infarct.

The study of the biological and cognitive underpinnings of emotion expression and comprehension has been the subject of intense study. Research has suggested that the right hemisphere is dominant for most but not all aspects of emotion processing. Lesions of the corpus callosum offer an opportunity to study the role of interhemispheric communication in the processing of emotional facial and vocal expression. Here we present a case of S.B., a 36-year-old, left-handed male, status post pericallosal artery infarct with resulting damage to the anterior corpus callosum and bilateral cingulate gyrus. Stereognostic testing confirmed hemispheric disconnection and left hemisphere dominance for language. The Florida Affect Battery was administered twice, with S.B. responding first with the left then, upon second administration, with the right hand. All tasks required a pointing response. It was hypothesized that S.B.'s right hand performance would be impaired because it is controlled by a left hemisphere disconnected from right hemisphere processing. Left hand performance was impaired relative to controls on facial affect but not prosody measures. In contrast, right hand performance was impaired relative to left hand performance on 5 of 10 subtests (4 of 6 prosody measures). These results suggest that the anterior corpus callosum is involved in the communication between hemispheres of information critical to emotion processing. The possible role of the cingulate in S.B.'s performance is also discussed.

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K. DAVIS GARRETT, C. LEE, C. McMILLAN, A. GOLDBERG, D.L. CHUTE, M. LIBERMAN, & M. GROSSMAN. Comprehension of Emotional Prosody in Parkinson's Disease.

While dysprosodic expression in Parkinson's disease (PD) has been well described, findings from investigations on the comprehension of emotional intonation have been mixed. In the present investigation, we sought to examine the comprehension of emotional and nonemotional prosody among individuals with PD ($n = 10$), neurologically healthy age and education-matched elders ($n = 7$), and college-age adults ($n = 16$). Stimuli included 1500 ms audio recordings of professional actors rendering utterances of minimal semantic content (i.e., dates, numbers) using emotional attitudes ($n = 90$, ranging from tentative to dominant) and nonemotional attitudes ($n = 90$, speaker close to intended listener, at a conversational distance, and far apart). Participants rated emotional attitudes and distance using a 5-point Likert scale. Between-group comparisons showed that PD patients and control subjects do not differ in their judgments of distance stimuli, but PD patients are less accurate than control subjects in their judgments of emotional stimuli [$F(2,24) = 8.58$, $p = .002$]. Within-group comparisons revealed poorer performance for emotional prosody judgments than nonemotional prosody judgments in PD [$t(9) = 3.29$, $p = .009$]; control groups did not differ in judgments of emotional and nonemotional prosody. There was no difference between groups in judgments of fundamental perceptual elements of prosody (pitch, duration, volume). Statistically significant correlations were seen between emotional prosody comprehension and a measure of working memory (letter-number sequencing, $r = .73$, $p < .001$) and recognition of emotional faces ($r = .48$, $p = .01$). These findings support the hypothesis that degradation of the frontal-striatal circuit in PD compromises the interpretation of emotional prosody comprehension. Factors contributing to this deficit include limited executive resources and poor comprehension of multi-modal emotional stimuli.

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K. DAVIS GARRETT, P. KOENIG, P. MOORE, C. DEVITA, J. LISTERUD, M. LIBERMAN, & M. GROSSMAN. Neurophysiological Correlations in the Comprehension of Emotional Prosody.

We examined the neurophysiological basis for prosody in 10 healthy, college-aged adults with functional magnetic resonance imaging (fMRI; 4 Tesla). Stimuli included brief (~1500 ms) audio recordings of professional actors rendering utterances of minimal semantic content (i.e., dates, numbers) conveying specific emotional and nonemotional (i.e., distance) attitudes. Participants judged aural stimuli blocked by emotional *versus* nonemotional features over 2 tasks presented in pseudorandom fashion: (1) explicit categorization (for affective material: Is the emotion expressed tentative, neutral, or dominant?; for nonaffective material: Is the distance between the speaker and intended listener very close, at a conversational distance, or far away?); and (2) a category-neutral condition (Is this something you might hear at a bus stop?). Across both tasks, the emotional-minus-distance contrast showed significant activation in the left orbital and ventral inferior frontal (BA 47/11; peak coordinates $x = -52$, $y = 16$, $z = -4$; z score = 4.03) and left dorsal inferior frontal cortex (BA 44/46; peak coordinate $x = -44$, $y = 20$, $z = 24$; z score = 3.57). For the distance-minus-emotional contrast, we found activation of medial parietal cortex bilaterally (BA 7; peak coordinates $x = -8$, $y = -48$, $z = 44$; z score = 4.36), left dorsal prefrontal cortex (BA8; peak coordinates $x = -32$, $y = 28$, $z = 44$; z score = 4.28), right dorsal prefrontal cortex (BA 10; peak coordinate $x = 12$, $y = 56$, $z = 8$; z score = 3.71), and striatum (peak coordinate $x = -16$, $y = 4$, $z = -8$; z score = 3.84). Emotional prosody appears to be supported by a neural network including orbital frontal cortex for interpreting emotional stimuli and dorsal inferior frontal cortex to support the complex, multi-factorial properties of emotional prosodic stimuli. Judging distance prosody seems to recruit a parietal-frontal circuit supporting spatial properties of auditory stimuli.

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A. RAYMER, D. BEVERSDORF, A. MITCHELL, D. WILLIAMSON, & K. HEILMAN. Emotion Word Ratings in Individuals with Parkinson's Disease.

The blunted emotional facial expressions and speech prosody in people with Parkinson's disease (PD) may be attributed to motor rigidity/akinesia affecting vocal fold and facial musculature. Impaired recognition of emotional prosody and facial emotions in PD subjects, however, suggests that emotional dysfunction is not entirely motor. To learn if PD also leads to changes in emotion conceptual-semantic systems, we examined interpretations of the emotional connotations of words in 8 PD subjects and 15 neurologically-normal subjects of a similar age and education. Using a 9-point visual scale, subjects rated 58 words for level of emotional valence (9 positive to 1 negative) and arousal (9 excited to 1 calm). As a control measure, they rated 30 words for level of expense (9 expensive to 1 cheap). Analyses of variance of the ratings revealed significant interactions between the groups and levels of valence ($p = .002$), arousal ($p = .02$) and expense ($p = .02$). When compared to the controls, the PD subject's emotional ratings for high and low valence words as well as low arousal words were blunted (deviated to the median). In contrast to emotional ratings, PD ratings for the mid and high expense words were increased relative to normal. Thus, the blunting of emotion ratings in PD subjects cannot be accounted for by a response bias and suggests that the aberrant emotional ratings of these PD subjects represents an alteration of their emotional conceptual-semantic systems. Patients with PD have many changes in their basal ganglia-frontal-limbic networks and how these changes influence emotional semantics remains to be determined.

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D. EVERHART, D. SHUCARD, J. SHUCARD, & R. BENEDICT. Adult Sex-Related ERP Differences in Facial Affect Perception.

In this experiment, sex-related differences in the left and right hemispheres' contribution to the processing of differing facial emotions were investigated. Visual event-related potentials (ERPs) were recorded from 20 (10 women and 10 men) colleged-aged subjects across 8 scale sights (F3, F4, T3, T4, C3, C4, P3, P4) while they performed an Affect Identification Task (AIT) that was developed in our laboratory. During the AIT, various facial affects (happy, sad, fear, angry, neutral) selected from Ekman's (1976) Pictures of Facial Affect are briefly presented (350 ms), and measures of reaction time, accuracy, and perceived intensity are obtained for each affective stimulus. ANOVA performed for behavior measures revealed no sex-related differences in reaction time, accuracy, or perceived stimulus intensity. Regarding main effects, happy affect was identified more quickly [$F(4,72) = 10.79$, $p < .001$] and accurately [$F(4,72) = 12.71$, $p < .001$] than other affects, and happy and fear affect were rated as more intense [$F(4,72) = 17.10$, $p < .001$] than were other affects. Analyses of the late components of the ERP revealed a significant Group $\times$ Affect $\times$ Hemisphere interaction [$F(4,72) = 10.79$, $p < .001$] for Peak 3 (P2 $-$ N2). *Post-hoc* comparisons for this interaction revealed greater left *versus* right hemisphere amplitude (microvolts) during the processing of angry faces for men and greater right versus left hemisphere amplitude during the processing of fear faces for women. The ERP data support the presence of sex-related differences in facial affect processing (though equally efficient between the sexes) that differ as a function of affect.

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V. INGRAM, M. KELLY, M. BAGGETT, & J. McCONNELL. Neuropsychological Impairment Following a Single Episode of Status Epilepticus.

In individuals with seizure disorders an impairment in neurophysiological performance is generally associated with disorder chronicity and earlier age of onset. For example, research has demonstrated that a generalized cognitive impairment is seen in mesial temporal lobe epilepsy patients when hippocampal sclerosis is present, and the presence of hippocampal sclerosis is associated with earlier age of seizure onset. A further pre-

sumed etiology of declination in cognitive functioning for patients with chronic seizure disorders includes long-term use of anti-epileptic medication. In general, a later age of onset with only a discrete seizure episode is not associated with hippocampal sclerosis or long-term cognitive sequelae. The current case however portrays an adult male with evidence of generalized cognitive impairment following a discrete series of seizures during transport to a hospital for a mild head injury. The head injury was identified as mild based on the patient's near immediate return to awareness only moments after slipping on a rock and striking the back of his head, in addition to clear neuroimaging. No previous seizure history was present, no additional seizures occurred post stabilization, and the patient's follow up EEG was within normal limits. Neuropsychological assessment conducted 5 weeks post injury suggested a generalized mild to moderate impairment across all cognitive domains measured. Serial assessment completed 10 months post injury indicated continued deficits in attention, new learning, memory, and speed of information processing. This unusual case demonstrates the potentially deleterious neurophysiological effects of a single episode of status epilepticus in an otherwise healthy individual.

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S. SHAMAY-TSOORY, R. TOMER, B. BERGER, & J. AHARON-PERETZ. Empathy Deficit Following Brain Damage: The Role of the Right Ventromedial Cortex.

Impaired empathic response has been described in patients following brain injury, suggesting that empathy—a process involving reactions of one individual to the observed experiences of another—may be a fundamental aspect of the deficit in social behavior reported in these patients. The neuroanatomical basis of empathy has not been studied in detail. Previous studies, however, suggested that the prefrontal cortex (PFC) may play an important role. We compared the empathic response in patients with PFC lesions ($n = 25$) to responses of patients with posterior lesions ($n = 17$) and healthy controls ($n = 19$). To examine specialization within the PFC, these patients were further assigned to 1 of 3 groups according to the localization of the lesion within the PFC: ventromedial (VM, $n = 12$). dorsolateral (DL, $n = 6$), and mixed ($n = 7$). PFC patients were significantly impaired in empathy as compared to both posterior lesions and healthy controls [$F(2,60) = 5.206$, $p < .05$]. Examination of the PFC subgroups revealed that only VM lesions were significantly different from either control group. However, among patients with posterior lesions, those with damage to the right hemisphere were significantly more impaired than those with left hemisphere lesions. The importance of the right hemisphere was supported by the finding that in 7 of 8 patients who were most impaired in empathy, the lesion involved the right VM. These findings suggest that the right VM cortex plays a unique role in integrating cognition and affect to allow empathic responses.

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J. WOLF, Y. KAMIO, & D. FEIN. Effects on Liking Ratings Following Subliminal and Supraliminal Affective Primes.

A study by Murphy and Zajonc (1993) demonstrated that subliminal presentation of affective primes influences liking judgments of subsequently presented target stimuli, with negative primes resulting in lower ratings of target stimuli. The present study sought to replicate these findings. Participants included 30 introductory psychology students (15 male, 15 female). Participants were asked to rate on a 5-point Likert scale the degree to which they liked a Japanese ideograph presented on a computer screen. The ideograph was preceded by a prime photograph of a happy face, fearful face, or neutral object. These primes were presented either subliminally or supraliminally (allowing conscious awareness). Analysis of variance revealed a significant interaction between prime, presentation length, and gender. *Post-hoc* analyses revealed a significant main effect of presentation length in females, such that the supraliminal condition yielded more positive ratings than the subliminal condition. Males showed a significant interaction between prime and presentation length, such that in the supraliminal condition, happy faces yielded significantly higher ratings than both fearful faces and objects, whereas in the subliminal condition, fearful faces yielded higher ratings than both happy faces and objects. The present findings are inconsistent with those of Murphy and Zajonc, which may be attributable to methodological differences. Participants were very similar, as was length of stimulus presentation, but the present study used fearful faces while the Murphy and Zajonc study used angry faces. Further research is needed to explore the parameters and replicability of the subliminal affective primes.

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J.W. VAN STRIEN, R. LICHT, L.M. J. DE SONNEVILLE, & L. VALSTAR. Implicit and Explicit Emotional Face-Processing: An ERP Study.

Divided visual field studies that require participants to perceptually match facial expressions commonly have found a left visual field (right hemisphere) processing advantage, irrespective of emotional valence. On the other hand, studies that require participants to evaluate emotional expressions have found differential laterality patterns for faces expressing positive and negative emotions. Usually, more happiness is perceived in faces presented in the right than in the left visual field. To further investigate the laterality of emotional face-processing, we examined the processing of faces in central vision as measured by event-related potentials (ERPs). The ERPs of 18 right-handed healthy volunteers were recorded during three conditions: a condition to study explicit emotional processing by requiring participants to judge facial expression, a condition to study implicit emotional processing by requiring participants to judge the facial gender of the faces, and a condition to study nonemotional processing by requiring participants to judge the facial gender of blurred faces. The blurred-faces condition was designated to block both explicit and implicit emotional face processing, while using more or less the same face stimuli. With blurred faces, emotions are much harder to judge than with non-blurred faces, but gender judgments still are possible. In the explicit processing condition, the evaluative component was emphasized by employing a forced-choice paradigm in which the participants were asked to rate the faces as either positive or negative. The data of this study will be discussed in terms of neurophysiological theories of emotion.

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Paper Session 12/9:00–10:45 a.m.

BRAIN INJURED CHILDREN

J. DONDERS & N. HOFFMAN. Memory After Pediatric Head Trauma: Boys Do Worse Than Girls.

Memory abilities of 30 boys and 30 girls with traumatic brain injury (TBI) were evaluated with the California Verbal Learning Test–Children's Version (CVLT–C). The sample was screened carefully to exclude children with premorbid neurological, psychiatric, or special education histories. There were no statistically significant differences between the two gender groups in terms of ethnicity, socioeconomic status, injury circumstances, length of coma, neuroimaging findings, time since injury, or age at assessment ($p > .10$ on all variables). However, boys performed worse on the CVLT–C composite T score than girls, $F(1,58) = 4.72$, $p < .05$. Although the univariate effect size ($\eta^2 = .08$) was somewhat small in this regard, it was far bigger than that reported previously in the standardization sample (<3%). Follow-up hierarchical regression analysis also suggested that gender accounted for a statistically significant amount of the variance (6%) in CVLT–C T scores, above and beyond that accounted for by injury severity parameters such as length of coma, which explained relatively more (20%) of this same variance. The gender difference in memory efficacy could also not be attributed to general language abilities because the 2 groups performed at nearly identical levels on the WISC–III Verbal

Comprehension index. It is concluded that male gender is associated with an increased risk for memory deficits after TBI and that boys may require earlier intervention and longer-term monitoring than girls in this regard.
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K.O. YEATES, H.G. TAYLOR, S.E. WOODROME, S.L. WADE, T. STANCIN, & D. DROTAR. Race as a Moderator of Parent and Family Outcomes Following Pediatric TBI.
Objective: Data from a prospective, longitudinal study were used to determine whether race moderates parent and family outcomes during the first year following pediatric traumatic brain injuries (TBI). *Method:* Participants included 73 white and 18 black children with moderate to severe TBI and their families, and 32 white and 23 black children with orthopedic injuries only (OI) and their families. Assessments of parent and family functioning occurred shortly after injury (baseline) and at 6 and 12 month follow-ups. *Results:* Race was a significant moderator of group differences in parental psychological distress and perceived family burden, by and large independent of socioeconomic status. The negative consequences of TBI were relatively less pronounced for parents of black children than for parents of white children at the baseline assessment, but became more pronounced at the 2 follow-ups. Black and white parents differed in their preferred coping strategies, which may partially account for their different reactions to their children's injuries. *Conclusion:* The sociocultural factors associated with race may moderate the effects of pediatric TBI and OI on parents and families.
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I. EMANUELSON, L. VON WENDT, G. HORNEMAN, & P. FOLKESSON. Outcome 10 Years After Injury in Children with Traumatic Brain Injury (TBI).
Objectives: To outline the long-term outcome in adolescents who suffered TBI in childhood. *Series:* 165 survivors (concussion excluded) injured during 1987–1991 in the age-group 0–17 years in the western Swedish health care region were identified. The traceable individuals (132) were invited to a follow-up investigation carried out as a questionnaire and an individual evaluation. This study reports the questionnaire data. *Methods:* The mailed questionnaire consisted of a postconcussion symptom checklist, a quality of life assessment form (D15), and a social and educational survey form. *Results:* The form was returned by 86/132 individuals. The reporting of subjective complaints revealed 11 individuals without any complaints, 12 with 1, 21 with 2 to 4, and 42 with 5 or more complaints. The most frequently reported problems all present in 40% were headache, mental lability, concentration, and visual field problems. The health-related QoL survey identified 22% of individuals perceiving their QoL as uncompromized, whereas visual problems were reported in 34%, anxiety in 32%, depression in 29%, and medical complaints in 27%. *Conclusion:* On a general level these individuals appear to be well-adjusted in society as there were only 2 without any daily activity. The fact that there were only 2 university students, although 20 continued their high-school degrees, raises a suspicion that the ability to conduct higher level of education is seriously impaired. Another concern is the high proportion of symptoms and the low perceived QoL.
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G. HORNEMAN, I. EMANUELSON, L. VON WENDT, & P. FOLKESSON. Traumatic Brain Injury in Childhood, Neuropsychological Outcome Ten Years After Injury.
Objectives: Long-term outcome in adolescents who suffered TBI in childhood. *Series:* 165 survivors of TBI (concussion excluded) injured during 1987–1991 in the age-group 0–17 years were identified. The traceable individuals (132) were invited to a follow-up investigation of whom 37 accepted and took part in a neuropsychological and neurological investigation 10 years post injury. None of those 37 individuals had been offered rehabilitation services and none had been offered medical follow-up. Eight of the 37 still showed neurological sequelae. *Methods:* Vocabulary and Block Design from WISC–III and WAIS–R, Rey Auditory Verbal Learning Test, Rey Complex Figure Test, Children's Category Test, and de Renzi and Faglioni Token Test were performed. *Results:* Vocabulary revealed 24/37 normal results (65%) whereas Block Design showed 29/37 (78%) normal results. RAVLT subtest total learning showed that 24/37 (65%) were within normal range whereas retention results revealed 29/37 (78%) normal values and delayed recall 30/37 (81%) Rey Complex Figure Test revealed 20/34 (59%) normal values. The performance on the Children's Category Test gave 27/36 (75%) normal results. In the Token Test 1/36 failed. *Conclusions:* This subgroup did not differ from the original group concerning severity of injury and length of unconsciousness. They demonstrate the natural course of recovery as none received rehabilitation and show a surprisingly high amount of cognitive malfunctioning. The most striking feature is the impaired verbal learning capacity and the memory disturbance.
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H. PANIUCKI, K. KRULL, D. MAHONEY, B. MUELLER, & P. BROUWERS. Effect of Cerebrovascular Complications and Gender on Children with Sickle Cell.
Children with sickle cell disease (SCD) are at increased risk for cerebrovascular complications (CC). Previous research suggests that the long-term consequences of CC on neurobehavioral functioning may be influenced by age at insult and gender. We investigated the influence of gender on the neurobehavioral profile of 29 children (19 male and 10 female; mean age = 11.19 years) with sickle cell disease, of which 12 (6 male and 6 female; mean age = 10.41 years) had evidence of a CC. All children were evaluated with a comprehensive age-appropriate battery of standardized neuropsychological tests focusing on general mental abilities, verbal and nonverbal functioning, and memory. On tests of general mental abilities children without CC in general scored better than children with CC. On verbal intellectual functioning females performed better than males, but no effect of gender was observed on nonverbal functioning. A significant interaction indicated that females with CC appeared to be compromised on nonverbal functioning and relatively spared on spatial functioning compared to males on these same measures. On measures of nonverbal and verbal memory, again children without CC performed better than children with CC. A significant interaction indicated that children with CC performed better on long-term recall than short-term recall, regardless of modality, where no such differential was found for the children without CC. These preliminary data suggest that CC's in sickle cell disease may be associated with differential effects on neurobehavioral functioning and possibly moderated by the effect of gender.
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S.R. BEERS & M.D. DE BELLIS. Cognitive Function in Pediatric Posttraumatic Stress Disorder.
Posttraumatic stress disorder (PTSD) is now widely recognized in the pediatric population. Recent neuroimaging studies indicate both diffuse central nervous system effects (De Bellis et al., 1999) and medial prefrontal cortical dysfunction (De Bellis et al., 2000). However, cognitive function using neuropsychological methodology has not been extensively evaluated and there is scant literature addressing neuropsychological aspects of childhood PTSD. In one controlled study, Morandi et al. (2001) found general memory deficits in PTSD children, but they did not assess other cognitive domains. *Method:* We examined cognitive status in 14 patients with maltreatment-related PTSD (11.38 ± 2.60 years) and 15 healthy subjects (12.17 ± 1.76 years). Groups did not differ on age, sex, socioeconomic status, or FSIQ. Instruments included measures of language, attention and executive skills, learning and memory, visual-spatial processing, and psychomotor function. *Results:* Controlling for experiment-wise error, PTSD subjects performed more poorly on measures of attention (Stroop Color/Word score, $p = .01$; Digit Vigilance omission errors,

$p = .006$) and executive function (Animal Naming, $p = .007$; Wisconsin Card Sort category score, $p = .01$). PTSD symptoms of intrusive thoughts, avoidance behavior, and increased arousal were associated with poorer performance on these measures. *Conclusions:* Children with maltreatment-related PTSD experience cognitive deficits consistent with prefrontal cortical changes identified by functional neuroimaging procedures. While we did not replicate the findings of Morandi et al., we noted significant trends on the delayed free recall score from a verbal memory test. Further research is needed to ascertain how psychiatric symptoms interact with neuropsychological deficits in children with PTSD.

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K. RADONOVICH, M. PULSIFER, M. O'REILLY, J. HOFFMAN, H. BELCHER, & A. BUTZ. Role of Postnatal Factors on Cognitive Development in Drug-Exposed Children.

Previous studies have reported a lack of significant differences in cognitive functioning between drug-exposed and non-drug-exposed children; however, few studies have examined the role of the postnatal environment on cognitive development in these children. Drug-exposed ($N = 96$) and control subjects ($N = 22$) were matched for gestational age, current age (4 years), and SES. Caregivers of these children were compared on measures of intelligence (WAIS–R) and academic achievement (WRAT–R). One-way ANOVAs revealed no significant differences between the drug-exposed and control groups on measures of intelligence, school readiness, verbal and visual reasoning, graphomotor skills, or visual attention. Caregivers of drug-exposed subjects had significantly lower WAIS–R FSIQ and WRAT–R reading scores. Results also showed significant correlations between the child's intelligence (Stanford–Binet) and caregiver's WAIS–R FSIQ and WRAT–R reading scores. Regression analyses revealed that caregiver's IQ and reading scores accounted for the largest variance in child's IQ, while other prenatal (drug and alcohol exposure, head circumference) and postnatal (continuing drug use) factors were not significant. These preliminary findings suggest that the greatest risk factor for young children with prenatal cocaine/heroin exposure may be their postnatal environment, including low maternal intelligence and low reading level. Additionally, although the children's IQ scores at this age appear similar, the correlation with the caregivers' IQ scores (which are significantly different) suggest potential IQ differences in the future. It appears that the lack of intellectual stimulation in the home places these children at risk for later problems with learning and intellectual progression. Implications will be explored.

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Paper Session 13/9:00–10:45 a.m.

PSYCHOTHERAPY AND COGNITION

M.R. BASSO, N. LOWERY, C. GHORMLEY, R. PURDIE, J. NEEL, & R. BORNSTEIN. Neuropsychological Impairment and Psychosis in Mania.

A growing body of evidence indicates that mania is associated with a variety of structural and functional cerebral abnormalities. Notably, some data suggest that these anomalies coincide with neuropsychological impairment especially involving concept formation and memory. Yet, not all individuals with mania demonstrate such deficits. It seems possible, however, that manics with psychotic features may be more inclined than their nonpsychotic counterparts to show cognitive impairment. For instance, past research involving unipolar depressives indicated that those with psychotic features appeared impaired, whereas those without psychotic features did not. In the present study, 40 bipolar manic inpatients (15 nonpsychotic, 25 psychotic) and 25 control subjects were administered COWAT, Trail-Making Tests A & B, CVLT, Grooved Pegboard Test, and the MMPI–2. The groups were equivalent in age and education. Data were analyzed using one-way ANOVA, and to protect against Type I error, Tukey LSD group comparisons were computed. Results showed that manic patients performed worse than the control subjects on all neuropsychological measures, and, relative to normative estimates, their performance was mildly to moderately impaired. In comparing patients with and without psychotic features, there were no significant differences. Effect sizes were uniformly low between the patient groups. Thus, this null effect was unlikely due to insufficient power. These findings suggest that mania is associated with significant neuropsychological impairment, independent of psychosis. They further indicate that presence of psychotic features does not predict greater relative impairment among manic individuals. Implications of these findings for clinical practice and theorized neural substrates of mania are discussed.

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G.G. BROWN, P. GOLDIN, R. NOTESTINE, & J. LOHR. Computational Analysis of Working Memory in Schizophrenia and Bipolar Disorder.

Although working memory deficits among schizophrenia patients have been frequently reported, questions about the specificity of the deficits remain. We studied 28 patients meeting DSM–IV criteria for schizophrenia, 46 bipolar patients, and healthy controls (HC). Subjects completed the Verbal and Figural subtests of the Continuous Paired Associates Test, which measures recognition memory of item-pairs across 5 lags. A Profile Analysis (Group, Subtest, Lag) showed that schizophrenia patients recognized significantly fewer items than HC subjects, $F(1,54) = 10.402$, $p = .002$, $\eta^2 = 0.162$, regardless of type of material studied (Group by Subtest interaction, n.s., $\eta^2 = 0.006$). Additionally, the contrast in performance between lags 0 and 1 differed by Subtest and by Group, $F(1,54) = 4.915$, $p = .031$, $\eta^2 = .083$, suggesting subtle differences of working memory impairment between Verbal and Figural subtests. We investigated this possibility by fitting parameters of a computational model of short-term working memory to each subject's performance. The analysis indicated that although schizophrenia patients were impaired on all 3 parameters of the model (Attention, Rehearsal Span, Memory Encoding), the Attentional parameter was more impaired among schizophrenia patients on the Figural Subtest than on the Verbal Subtest. Bipolar patients did not differ from HC subjects on either performance or model parameters. These results indicated that (1) the working memory impairment in schizophrenia is not material-specific, (2) among individuals with severe psychopathology, working memory impairment may be specific to schizophrenia patients, and (3) impaired attention contributes more to impaired Figural working memory than impaired Verbal working memory.

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A.M. BRICKMAN, L. SHIHABUDDIN, P.D. HARVEY, S.A. MITELMAN, C. TANG, R. PRIKHRYL, R. MIOZZO, K.L. DAVIS, & M.S. BUCHSBAUM. Recent Evidence to Support a "Kraepelinian" Subtype of Schizophrenia.

The clinical heterogeneity of schizophrenia has prompted many attempts to establish valid subtypologies. One classification system groups schizophrenia patients as either "Kraepelinians" or "non-Kraepelinians" based on analysis of self-care deficits. Kraepelinians have a progressive poor outcome and are completely dependent on others for basic needs. Non-Kraepelinians have a relatively better outcome and course. Two groups of schizophrenics were characterized as Kraepelinian or non-Kraepelinian. One group was assessed with a neuropsychological battery; the other received comprehensive assessment of brain structure with MRI. *Methods:* Fifty-two schizophrenics (26 Kraepelinians, 26 non-Kraepelinians) received neuropsychological assessment, including CVLT, Trailmaking, and Animal Naming, in addition to clinical assessment with the PANSS. Thirty-seven schizophrenics (13 Kraepelinians, 24 non-Kraepelinians) were assessed with structural MRI and diffusion tensor, which measures the

direction and coherence (anisotropy) of white matter bundles. *Results:* Kraepelinians performed significantly worse on most neuropsychological measures, but did not differ on CVLT long- and short-delay cued recall, perseverations, and recognition memory and on Category Fluency. CVLT intrusions and fifth trial learning were the best predictors of Kraepelinian status as demonstrated with discriminant function analysis. Kraepelinians had significantly smaller temporal and occipital, but equal frontal lobe volume and smaller putamen volume than Non-Kraepelinians. While matter integrity analysis revealed that Kraepelinians had reduced anisotropy in the temporal lobe and in the splenium of the corpus callosum. *Conclusion:* These findings further support the validity of the Kraepelinian/non-Kraepelinian classification and suggest a unique neuropsychological profile for each group. The neuroanatomical differences are perhaps indicative of an underlying neurodegenerative abnormality in the Kraepelinian patients.
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R. LANCASTER, J. EVANS, P. LYSAKER, & G. BOND. Neurocognition, Social Cognition, and Social Function in Schizophrenia Patients.
Green and Nuechterlein (1999) proposed a model for schizophrenia, in which they named social cognition as a potential mediator between basic neurocognition and functional outcome. The current study sought to examine this relationship in a sample of 40 chronic male schizophrenia patients. Basic neurocognition was measured with a comprehensive neuropsychological battery that examined attention, memory, learning, and executive functioning. Social cognition consisted of measures of social problem solving (Means Ends Problem Solving Test, MEPS) and social cue recognition (Social Cue Recognition Test, SCRT), and functional outcome focused on social functioning (Social Adjustment Scale, SAS). Results indicated that the 2 measures of social cognition were correlated ($r = .451$, $p < .01$). The summary neurocognition score was significantly correlated with both measures of social cognition, the MEPS ($r = .35$, $p < .05$) and the SCRT ($r = -.56$, $p < .01$) but not to any of the SAS subscales or the SAS total score. We also did not find evidence of a relationship between social cognition and social functioning. Finally, we found no evidence of a mediating relationship between neurocognition, social cognition, and social functioning, since social cognition did not explain a significantly greater proportion of the variance in social functioning than neurocognition alone. Thus, this study confirms that neurocognition and social cognition are related. However, it did not find that either of these domains are related to social functioning in people with schizophrenia. This may require further study in a larger sample of patients.
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J. EVANS, P. MEYER, H. KIM, P. LYSAKER, & G. BOND. Cognitive Predictors of Success in Vocational Rehabilitation in Schizophrenia.
Cognitive impairments in schizophrenia appear to be associated with social problem solving, social and vocational functioning, and psychosocial skill acquisition. The present study examined the relationship of cognitive functioning, as well as clinical symptoms, to vocational outcomes among chronic schizophrenia patients. Seventy-eight patients with DSM–IV schizophrenia spectrum diagnoses underwent a comprehensive neuropsychiatric evaluation as part of a larger study examining the effectiveness of best practices in vocational rehabilitation in conjunction with atypical antipsychotic medication. The neuropsychological evaluation examined verbal learning and memory, attention, speed of information processing, and executive functioning. Clinical symptomatology was evaluated with the Positive and Negative Sundrome Scale (PANSS). Vocational outcomes were assessed 4 months after entry to the program and included the Work Behavior Inventory (WBI). At 4 months, 70% of the sample were either working or receiving vocational services. Stepwise multiple regression analyses found that among baseline clinical and cognitive predictors, only verbal learning and memory and cognitive disorganization symptoms were significant predictors of work behaviors 4 months later. These results provide further evidence of the relationship between cognitive performance and functional outcomes. Future research will examine whether atypical medications improve cognitive function, which in turn may lead to better work outcomes.
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M.A. FISHER, J.H. POOLE, & S. VINOGRADOV. Clinical Correlates of Reality Monitoring and Source Recall in Schizophrenia.
Prior research has suggested that individuals with schizophrenia are impaired in their ability to remember and discriminate between various sources of information. The present study investigates the specific sources of information schizophrenic individuals have difficulty discriminating and examines the association between these errors and clinical symptoms. We evaluated 102 clinically stable schizophrenic outpatients and 28 healthy controls using 2 separate measures related to internal and external source monitoring ability: The California Verbal Learning Test (CVLT), which includes a component requiring subjects to discriminate between 2 external sources, and the Johnson Reality Monitoring Test (RMT), which requires subjects to discriminate between internal and external sources. The schizophrenic group had normal recognition memory on both tasks but made significantly more source recall errors than controls on both tests. Specifically, they had more difficulty recognizing the source of internally generated items, as well as failures to distinguish between several types of external sources. Analysis of symptom ratings on the Positive and Negative Symptom Scale (PANSS) indicated that reality monitoring errors were associated with more severe negative symptoms and certain disorganized symptoms. External source monitoring errors were associated with more severe disorganized symptoms and agitation in some patients. This analysis indicates that these measures can make a valuable addition to neuropsychological evaluations, particularly with patients who may have psychotic spectrum disorders.
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M.R. BASSO, N. LOWERY, C. GHORMLEY, R. PURDIE, & J. NEEL. Melancholia Mediates Neuropsychological Impairment in Bipolar and Unipolar Depression.
A growing body of research indicates that bipolar and unipolar mood disorders are associated with cerebral abnormalities. For instance, a number of studies demonstrate that major depressives display evidence of frontal and temporal structural abnormalities and hypometabolism relative to controls. There also are indications that these abnormalities accompany neuropsychological impairment in depression, particularly involving executive function and memory. However, only some bipolar and unipolar depressives display cognitive deficits, and it is unclear what factors contribute to their development. Some research suggests that unipolars displaying the melancholic subtype of depression are more inclined to demonstrate deficits involving executive function, attention, and memory. In the present study, we examined the extent to which melancholic features among 12 bipolar and 33 unipolar depressed inpatients predicted deficits across a broad range of neuropsychological function. Patients and 25 control subjects were administered COWAT, Ruff Figural Fluency, Trail-Making Tests A and B, WMS–3 logical memory, faces, spatial span, digit span, letter-number sequencing, Grooved Pegboard Test, and the MMPI–2. Melancholic features were assessed with the CORE (Parker et al., 1994). The CORE is a clinician administered behavior rating form that focuses upon retarded movement, flattened affect, and diminished initiative. Multiple regression analyses revealed that the CORE, independent of age, education, and emotional distress predicted neurobehavioral impairment across the battery. As such, bipolar and unipolar depressives with melancholic features more commonly demonstrate cognitive impairment than those without such features. Implications of these findings for clinical practice and theorized neural substrates of depression are discussed.
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Symposium 9/9:00–10:45 a.m.

NEUROIMAGING OF THE WHITE MATTER OF THE BRAIN

Organizer & Chair: Carol L. Armstrong

C.L. ARMSTRONG. Neuroimaging of the White Matter of the Brain.
Interest in the cognitive significance of the brain's white matter (WM) is advancing assumptions about disease and normal aging because of the quantitative regional analyses that are possible by new methods of neuroimaging. We present current findings on magnetic resonance (MR) techniques without injection of radioactive ligands that permit inspection of the WM's neural integrity [diffusion tensor imaging (DTI), MRI volumetric analyses, magnetization transfer imaging (MTI), and MR spectroscopy (MRS)]. The WM is a common substrate for many neurological diseases as well as normal aging, and these techniques can advance our understanding of both disease and normal cognition through the mapping of cognition onto specific WM structures—a neglected area. Each presenter will describe the technical aspects of a different MR method, and will review findings in normal and neurological populations to give the audience an understanding of the significance of the technique's indices. Sullivan will present clinical findings from DTI on the microscopic structural changes in WM fiber coherence associated with normal aging and alcoholism. Raz and Gunning-Dixon will give their observations on MRI measures of WM volumetric changes in regional associations with cognition in the study of normal aging. Armstrong and Ledakis will review MTI's measurement of myelination in the study of WM in a variety of neurological diseases, and findings on the mapping of normal attention and memory onto WM structures. Yeo and Brooks will interpret their findings on the value of brain metabolites of the WM in predicting cognitive function in normal aging and in clinical populations.
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E.V. SULLIVAN. Effects of Age and Alcoholism on White Matter Microstructure—Diffusion Tensor Imaging.
The development of magnetic resonance Diffusion Tensor Imaging (DTI) for clinical use permits depiction and quantification of the diffusion properties of white matter of tracts and fibers in terms of their orientation and coherence. Application of DTI in human studies provides the unique opportunity of *in vivo* examination of white matter microstructural degradation reported in neuropathological study of aging and alcoholism, and possible previously only in post-mortem study. Here, we review our DTI studies, which have revealed age-related decline in regional white matter integrity at the microstructural (intravoxel coherence) and macrostructural (intervoxel coherence) levels and lack of sex-related differences across the adult age range. These DTI measures also have functional ramifications because degree of regional white matter coherence correlated with gait, balance, and interhemispheric transfer test performance. Taking these normal age-related differences into account, alcoholic men were observed to have less intravoxel and intervoxel coherence even in regions of fully-volumed white matter. Regions showing the greatest differences from controls were the centrum semiovale and the genu of the corpus callosum. Microstructural abnormalities occurred even though the volumes of the regions measured were similar in the 2 subject groups. The results further indicate that declines in white matter coherence may contribute to deficits in attention and working memory, which commonly occur in patients with chronic alcoholism. These age- and alcoholism-related declines in white matter fiber coherence may reflect changes in myelination, axonal integrity, and accumulation of extracellular fluid observable at the microstructural level.
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N. RAZ & F. GUNNING-DIXON. Cognitive Correlates of White Matter Abnormalities in Normal Aging.
In the course of normal aging, the brain exhibits multiple differential changes. Although (in contrast to the gray matter) there may be little age-related shrinkage of the white matter volume, significant age differences in other indices of white matter integrity have been observed. Cerebral white matter of asymptomatic people frequently exhibits circumscribed areas of hyperintensity on magnetic resonance images. Age, a history of transient ischemic attack/cerebrovascular accident, and a history of hypertension predict presence and size of the white matter hyperintensities (WMH). White matter abnormalities observed on MRI are associated with attenuated performance on many cognitive tasks, especially those that measure processing speed and executive functions. Regional differences in the impact of WMH on cognition are observed. Shrinkage of the prefrontal gray matter and increase in prefrontal WMH burden may independently contribute to age-related declines in executive functions. Whereas the influence of regional gray matter shrinkage on executive functions may be confounded with hypertension, the impact of WMH appears independent of the age-related differences in blood pressure.
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C.L. ARMSTRONG & G.E. LEDAKIS. The Significance of Magnetization Transfer Imaging in Measuring Cognition and White Matter Damage.
Magnetization transfer imaging (MTI) has been shown to differentiate edema and demyelination, detect occult white matter abnormalities, and measure wallerian degeneration. Its application to neurological injury is based on the exchange of magnetization between freely mobile water protons and macromolecule water protons in brain cells. Its use in cognitive studies of clinical populations is limited. We will review (1) the technical aspects of MTI, (2) MTI's utility in diagnosis of lesions in neurological diseases [e.g., multiple sclerosis (MS), traumatic brain injury (TBI), and ischemic vascular dementia], (3) our findings from a neurologically-normal sample including MTI's correlation with cognitive functioning (memory and attention), and (4) MTI's clinical utility in the study of brain irradiation (XRT) effects in patients with primary brain tumors. As XRT is known to cause or exacerbate demyelination and damage to blood vessels causing ischemia, MTI is a useful tool to measure the effects of XRT on normal appearing white matter. We examined the association of MT ratios (MTR) for 35 brain regions of interest with demographic and cognitive variables in both age-matched normal control subjects and in irradiated brain tumor patients. MTRs were acquired immediately prior to XRT, and at 4 follow-ups during the first 2 years to measure the early-delayed phase of XRT. Results demonstrate the effectiveness of MTI in the measurement of XRT injury, and that integrity of the white matter can be associated with cognitive function in measures that reflect cognitive process (e.g., reaction time) more so than in measures that are data-driven (e.g., learning capacity).
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R.A. YEO & W.M. BROOKS. Neuropsychological Correlates of Magnetic Resonance Spectroscopy in Normal and Diseased Brain.
Over the past decade magnetic resonance spectroscopy (MRS) is increasingly used as an imaging tool for examining neurometabolites *in vivo*. It has contributed substantially to our understanding of disorders as diverse as schizophrenia and traumatic brain injury (TBI). We will review technical aspects of proton MRS, including types of image acquisition, data analysis, and the functional significance of the most commonly observed metabolites [choline-containing compounds (Cho), creatine-phosphocreatine (Cre), and *N*-acetyl-aspartate (NAA)]. Secondly, in studies of normal individuals, we found that young adults' NAA from occipito-parietal white matter (WM) strongly correlated with intelligence and overall neuropsychological performance, especially on tasks that have a "speeded" component. Most recently, we examined NAA and cognitive

performance in a sample of healthy elderly individuals. As compared to young adults, NAA was lower in every WM voxel examined; within the elderly sample age was negatively correlated with only left frontal WM NAA. In general, higher NAA predicted better performance. Thirdly, we will review our studies of WM MRS in selected diseases. We have previously reported that MRS distinguishes WM hyperintensities in normal aging from those in Binswanger's disease (BD). We now report that regional WM NAA predicts overall lesion load in BD, which is strongly related to cognitive deficits. In TBI, WM NAA and Cho initially decline after injury, though NAA appears to increase between 3 and 6 months post-injury. We will present new data on spectroscopic imaging and TBI in children.

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Symposium 10/9:00–10:45 a.m.

CURRENT CONTROVERSIES IN ADULT LEARNING DISABILITY

Organizer & Chair: Lorraine E. Wolf

L.E. WOLF, C. WEINSTEIN, C. ARMENGOL, L. MOES, & R. MAPOU. Current Controversies in Adult Learning Disabilities.

Learning disabilities (LD) have traditionally been considered a childhood disorder. Yet these conditions do persist into adulthood and continue to profoundly impact adult life. Adults with LD face unique educational, social, clinical, and occupational challenges. Some of these problems are most clearly apparent in higher educational settings. After nearly thirty years of disability and education law, increasing numbers of LD students have been able to enter college. As persons with disabilities, these students are eligible under the law to receive academic accommodations, services, and supports to assist in their pursuit of an education. This has made it possible for many LD students to successfully complete undergraduate degrees and go on to pursue graduate and professional study, including law and medicine. While this development is clearly a positive result of the disability rights movement, considerable controversy exists within the advocacy community, the major professions, and the public at large. This symposium will address some of the newer issues that have recently come to light in working with this population. Two speakers will address public policy and demographics, while two speakers will present recent research. Following Dr. Wolf's overview of the assessment, statutory, and clinical issues in the LD college student, Dr. Weinstein will present recent ethical and legal challenges to professional licensing exams for LD medical and law students, Dr. Armengol will present data addressing assessment of bilingualism in the LD adult, and Dr. Moes will present data suggesting that slow reading speed may be a subtype of adult dyslexia related to dopamine deficiency.

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L.E. WOLF. Postsecondary Education and the Student with LD.

The right of college students with disabilities are protected under the Americans with Disabilities Act of 1990 (ADA) and Section 504 of the Rehabilitation Act of 1973. The increased presence of LD students on campus creates new demands for colleges and universities, as these statutes mandate postsecondary institutions to provide reasonable academic and program adjustments ("accommodations") to qualified students with disabilities, including LD. There are no specifications at the postsecondary level, however, for defining eligibility such as those codified for elementary and secondary students, nor is there any consensus on assessment standards. Although universities may set their own policies regarding documentation, there has been a recent move towards establishing some national standards. Accuracy in diagnosis of learning disorders in college populations is particularly important so those students who merit academic modifications are properly identified. The neuropsychologist working within such a framework is arguably in the best position to properly document and thus secure accommodations for their college age clients with LD. This talk will provide an overview of the scope of the problem, including recent postsecondary statistics, outcome for students with LD, and clinical versus legal determination of LD in adults. Relevant statutes will be reviewed, including the Individuals with Disabilities Education Act, the Americans with Disabilities Act, and Section 504 of the Rehabilitation Act. Finally, the rights and obligations of the university and the rights and responsibilities of the student will be discussed.

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C. WEINSTEIN. Ethical and Legal Issues in Professional Students with LD.

Students with documented learning disorders are advancing to college, professional schools, and graduate education. Federally mandated accommodations both in college, graduate school, and when taking entrance examinations (e.g., Medical College Admission Examinations) provide the necessary support for individuals with learning disorders to perform competitively. Notably, the number of newly diagnosed students has increased significantly. For example, there were 36 requests in 1990 for accommodations for the Medical Licensure Examination and 1000 requests in 1998 (Gordon and Keiser, 1998). The neuropsychological evaluation of college/graduate students with learning disorders has been an important tool for this population: guiding understanding of strengths and weaknesses, clarifying diagnostic issues, and delineating appropriate accommodations. There have been, however, several recent court challenges in which students have requested accommodations for State Bar examinations and the National Board of Medical Examiners. These rulings have significant implications for the neuropsychologist because the definition of a disability and the intent of the Americans with Disabilities Act and Section 504 of the Rehabilitation Act are being challenged. Specifically, the court has ruled that an individual must have a physical or mental impairment that substantially limits a major life activity compared to the general population. Recent court cases (*Price v. The National Board of Medical Examiners*; *Gonzales v. NBME*; *Bartlett v. New York State Board of Bar Examiners*) will be reviewed, and the implications of self-accommodations and compensatory strategies will be addressed.

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C. ARMENGOL. Determining Verbal Learning Disabilities in Foreign Language College Students.

It was estimated that over one half million foreign students are enrolled in colleges and universities in the United States in the year 2000, an almost 5% increase over the previous year (Institute of International Education, 2000). Most programs hosting foreign students offer cultural orientations, intensive English language programs, and other assistance. Even with this support many international students encounter academic difficulties when attending American institutions of higher education. Clearly a major obstacle is related to difficulty in academic learning in a nonnative language. Consequently, colleges and universities are frequently asked to decide whether academic difficulties experienced by foreign bi- or multilingual students are a function of unfamiliarity with English or the result of a language-based learning disability. The neuropsychologist is challenged to make informed conclusions regarding this issue. Use of the Test of English as a Foreign Language (TOEFL) as a means of gauging English language proficiency will be analyzed, together with important questions to address during the interview with the student. The use of ability versus achievement tests, stressing the need to take into account educational parity issues, and normative data limitations, will be discussed. Data will be presented regarding slowed processing as a multilingual student inhibits his/her primary language while reading in a second language. Finally,

appropriate methods to assess core phonological decoding skills in foreign language speakers will be proposed.
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E. MOES. Controversial Issues on Reading Disabilities: Slow Reading and Dopamine Deficiency?
There are many myths about dyslexia including: it can be outgrown, smart people cannot be dyslexic, eye training is a treatment, and more boys than girls are dyslexic. Even when remediated or compensated, one of the most enduring features of dyslexia is slow reading. Considerable attention has focused on decreased phonological processing as the core deficit in dyslexia, with relatively less exploration of slowed reading. We know that the average nondisabled college student reads at a rate of about 300 words per minute and demonstrates a positive relationship between reading speed and reading comprehension, with slower reading being associated with reduced comprehension. Yet students with reading disabilities typically read at a much slower rate which compromises their understanding of text. This segment of the symposium will review existing interpretations and evidence for slow reading speed, including phonological decoding deficits, orthographic retention deficits, magnocellular visual processing deficits, and the double deficit hypothesis. Evidence regarding the existence of a subgroup of slow readers who do not fit the above models is presented in the context of a new model of slow reading based on dopamine deficiency, predominantly thought to operate at the retinal level. Implications for assessment, diagnosis, treatment, and reasonable accommodations are addressed.
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Plenary Speaker/11:00 a.m.–12:00 p.m.

OUTCOME MEASURES IN CLINICAL TRIALS IN ALZHEIMER'S DISEASE

David S. Knopman

FRIDAY AFTERNOON, FEBRUARY 16, 2002

Poster Session 5/12:00–2:30 p.m.

FORENSIC

M.F. GREIFFENSTEIN & W.J. BAKER. Head Injury Severity Is Inversely Related to Symptom Validity Tests in Poor Outcome Patients.
Miller (1972) caused great controversy by asserting that the more minor a craniofacial injury in compensation-seeking patients, the more florid the symptom production. This was an impressionistic judgment but no correlational data was offered. We tested his assertion by giving a battery of symptom validity measures to a wide severity spectrum of litigating head injury claimants. In order of increasing severity, the sample included whiplash ($N = 92$), benign concussion ($N = 141$), mild closed head injury (CHI) ($N = 111$), moderate CHI ($N = 25$), and severe CHI ($N = 74$). The unweighted linear terms of several ANOVAs showed significant inverse linear trends for PDRT scores ($p < .001$), averaged Halstead Grip Strength ($p < .001$), Rey 15 Item ($p < .001$), and MMPI *Sc* scale ($p < .008$). For example, the PDRT group means in order of ascending injury severity is whiplash 59%, benign head trauma 66%, mild CHI 64%, mod CHI 75%, and severe CHI 76%. We did not find any between-groups effects on the MMPI *F* and Gough Dissimulation indices. Essentially, chronic whiplash and minor head injury litigants performed consistently more abnormally than patients with moderate to severe CHI. The performances appear "tailored" to fit expectations of a closed head injury, as there was no evidence for manufacture of psychotic symptoms. These findings support Miller's (1972) impressionistic observations of symptom embellishment as a function of injury severity and duration of disability.
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J.L. LEWIS, A.J. SIMCOX, & D.T.R. BERRY. Screening for Malingered Psychological Symptoms With the MMPI–2 and SIMS.
Malingering during forensic neuropsychological evaluations may involve feigning of psychological, neuropsychological, or both types of deficits. However, the neuropsychological literature has rarely focused on detecting feigned psychological symptoms. In the present study, 55 males undergoing pretrial psychological evaluations for competency to stand trial or criminal responsibility in the Federal Justice system were administered the Structured Interview of Reported Symptoms (SIRS), the MMPI–2, and the Structured Inventory of Malingered Symptoms (SIMS). None was diagnosed with a Factitious or Somatoform Disorder. Based on results from the SIRS, which agreed 96% of the time with clinical judgments regarding malingering, 31 subjects were classified as Honest responders and 24 as Malingerers. Malingerers were younger, facing longer potential sentences, and more likely to be diagnosed with ASPD than Honest subjects. Significant differences between the 2 groups were found on all SIMS scales as well as on the MMPI–2 F, Fb, Fp, & F-K validity scales. The SIMS Total Score and the MMPI–2 Fb scale were significantly predictive of group status in logistic regressions, and were most accurate in predicting group classifications, with hit rates of 90% and 91%, respectively. Based on this ecologically-valid, known-groups methodology both tests have potential utility as screens for malingered psychological symptoms in forensic neuropsychological examinations.
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G.J. LARRABEE. Neuropsychological Performance Patterns Indicative of Malingering.
Symptom Validity Testing (SVT) is sensitive to poor effort, but can be passed by sophisticated and/or informed malingerers (Youngjohn et al., 1999). The present investigation demonstrates that malingerers can also be identified through atypical neuropsychological performance patterns, and that use of multiple performance contingencies reduces the risk of false positive identification errors. Neuropsychological test performances of 28 Ss with moderate to severe closed head injury (CHI) were contrasted with test scores of 25 Ss claiming acquired brain injury, without objective neurologic evidence of brain dysfunction, and who performed significantly worse-than-chance on forced choice testing (malingerers; M). Review of prior research on malingering, and analysis of frequency distribution of CHI and M performance on neuropsychological tests identified 4 patterns suggestive of malingering: Combined (bimanual) raw score finger tapping < 63 (Heaton et al., 1978; Mittenberg et al., 1996); Lees-Haley Fake Bad Scale (FBS) > 22 (Millis et al., 1995); Reliable Digit Span < 8 (Greiffenstein et al., 1995; Meyers & Vollbrecht 1998); and Wisconsin Card Sorting Loss-of-Set (LOS) > 1 (present data set). When M and CHI were evaluated on the basis of all possible pair-wise malingering signs (e.g., FBS > 22 and LOS > 1), 76% of M and 93% of CHI were correctly

classified for an overall hit rate of 85%. This hit rate was superior to values reported in a recent meta-analysis of SVT (Vickery et al., 2001), which reported average sensitivity (true positive for M) of 56%, mean specificity (true negative for M) of 95.7%, and an average hit rate of 76.8%.

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M. CONSTANTINOU, L. ASHENDORF, S. O'BRYANT, M. WEBER, & R. McCAFFREY. The TOMM as a Predictor of NDS Indices in a Sample of Mild-TBI Litigants: A Cross-Validation Study.

Numerous measures have been developed for discriminating between individuals that put forth maximal effort during neuropsychological testing and those that do not. One of those measures is the Test of Memory Malingering (TOMM). Suboptimal performance is considered when a score below 45 is earned on the second and/or third trials of the TOMM. The TOMM was shown to be sensitive to the level of effort placed during neuropsychological testing. However, the TOMM was found to be insensitive to depression, age, education, and neurological conditions. In addition, in the past it was shown that litigants, who are considered to be at-risk for exhibiting suboptimal effort, tend to score lower on the TOMM than nonlitigants. The present study's goal was to cross-validate past findings which demonstrated that poor performance on the TOMM could be indicative of pseudo-poorer performance on the Halstead-Reitan Neuropsychological Test Battery (HRNB). Data analyses revealed that performance on the TOMM was indeed highly associated with the Neuropsychological Deficits Indices of the HRNB. In order to evaluate this finding further, the litigants were divided into 2 groups: (a) those who scored above or equal to 45 on the TOMM (TOMM $\geq$ 45) and, (b) those who scored below 45 (TOMM $<$ 45). The TOMM $<$ 45 group had significantly higher NDS scores, which are indicative of higher impairment, than the TOMM $\geq$ 45 group. Therefore, the data propose that poor performance on the TOMM can be associated with a generalized pseudo-poorer performance on other neuropsychological measures.

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M.F. GREIFFENSTEIN & W.J. BAKER. Premorbid Clues: Pre-injury Scholastic Performance and HRB Scores in Litigated Head Injury.

We obtained school records from 70 litigating head-injured patients of differing severity with persistent disability claims. All were administered the Halstead-Reitan neuropsychological test battery (HRB). We conducted both bivariate correlations and regression analysis. Within the late post-concussion group (LPCS, $N = 66$), GPA correlated significantly with Booklet Category Test, Speech Sounds Perception Test, and Halstead Impairment Index. Regression of HRB scores onto GPA within the LCPS group produced an R of .527, with 27.7% of variance accounted for. Given possible data corruption by invalid effort, we selected cases with Rey Word List scores of 7 or greater ($N = 45$). New analysis showed additional correlations with TPT total time and dominant hand tapping. Repeat regression analysis showed even more powerful associations, with $R = .67$ and $R^2 = .449$. There were no significant bivariate correlations between GPA and HRB scores in the severe CHI group ($N = 14$). Removal of potential underperformers from the severe group left 8 cases, but there were still no significant correlations. Our main conclusion is that premorbid scholastic performance accounts for much variance in HRB performance in the context of minor head injury. Failure to address this may result in false positive diagnoses of cerebral dysfunction long after minor injuries. Although our severe group was small, the data tentatively support Reitan and Wolfson's contention that demographic variables may be less contributory to test score variance in the context of severe brain cell loss.

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W. MITTENBERG, C. PATTON, E. CANYOCK, & D. CONDIT. A National Survey of Symptom Exaggeration and Malingering Base Rates.

The annual incidence or base rate of symptom exaggeration/malingering has been the subject of estimates that vary widely in magnitude and objectivity. Accurate base rate statistics are necessary for the calculation of diagnostic accuracy estimates. Base rates of exaggeration/malingering are reported from a survey of the ABCN membership. The response rate was 35% ($N = 131$). Respondents' geographic distribution matched that of the ABCN membership. Base rates of exaggeration/malingering did not differ among geographic regions or practice settings, but were related to the proportion of plaintiff *vs.* defense referrals ($r = .22$). Reported base rates would be 2% to 4% higher if variance due to referral source was controlled. The following estimates were based on 33,012 annual cases involved in personal injury ($n = 6{,}272$), disability ($n = 3{,}631$), criminal ($n = 1{,}321$), or medical ($n = 21{,}788$) matters: 29% of personal injury cases, 30% of disability claims, 19% of criminal cases, and 8% of medical cases involved probable symptom exaggeration/malingering; 39% of mild head injury, 35% of fibromyalgia/chronic fatigue, 31% of chronic pain, 27% of neurotoxic disorder, and 22% of electrical injury claims involved exaggeration/malingering. Diagnostic impressions were supported by multiple sources of evidence, including severity (65% of cases) or pattern (64% of cases) of cognitive impairment that was inconsistent with the condition, scores below empirical cutoffs on forced choice tests (57% of cases), discrepancies among records, self-report, and observed behavior (56%), implausible self-reported symptoms in interview (46%), implausible changes in test scores across repeated examinations (45%), and validity scales on objective personality tests (38%).

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K.W. GREVE, C.W. MATHIAS, K.J. BIANCHINI, & R.J. HOUSTON. Malingering on the WAIS: Validation of Mittenberg's Approach to Detection.

While neuropsychological examination may be the primary means of documenting the effects of subtle neurological insult in support of legal claims for financial compensation, the risk of malingering is high in this context. Traditional neuropsychological measures are particularly vulnerable to malingering because of their reliance on patient cooperation. The present study assessed the effectiveness of using WAIS performance validity markers devised by Mittenberg et al. (1995) in the detection of malingered neurocognitive dysfunction. Subjects were 65 traumatic brain injury patients referred for neuropsychological evaluation. Twenty-eight were seen as part of their legal/workers compensation cases and met the Slick et al. (1999) criteria for at least probable malingered neurocognitive dysfunction. Thirty-seven seen in the course of rehabilitation had no external incentive, and did not meet the Slick testing or self-report criteria for malingering. All subjects completed either the WAIS–R or WAIS–III. The Discriminant Function Score (DFS) was computed according to the Mittenberg formula and the Vocabulary–Digit Span (VDS) difference score was calculated. Sensitivity, Specificity, and Predictive Power were examined for several cut-off's for each marker individually and the 2 combined. Sensitivity, Specificity, and Predictive Power for the DFS were acceptable. The magnitude of these indices for VDS was less than for DFS. Further, both markers were highly correlated, so the use of the 2 in combination resulted in no incremental increase in classification accuracy compared to the use of DFS alone. Issues related to the clinical application of these techniques are discussed.

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J. ANDRIKOPOULOS. Disorientation in Mild Head Injured Litigants.

Suchy and Sweet (2000) found disorientation in 12 (24%) of 50 benefit-seeking patients. They suggested that this level of disorientation, particularly in a sample that should not experience disorientation, is comparable to published base rate studies of malingering. The present study examined disorientation to date and personal information/place as indicators of ma-

lingering following a mild head injury. A mild head injury group (N = 122) in litigation was compared to patient groups with diagnoses of a psychiatric condition (N = 69), Alzheimer's disease (N = 326), vascular dementia (N = 32), and moderate to severe closed head injury (N = 48) not in litigation. All patients were given the Benton Temporal Orientation Test. For orientation to personal information and place, the patient was asked to give the name of the town they reside in, their mailing address, age, birth date, name of the city that they are presently in and the name of the hospital or place. In the mild head injury group, disorientation to date and personal information/place was present in 7.4% and 5.7% of the sample, respectively, and significantly less than that was found in the other 3 neurological groups. Disorientation to date was more common in the mild head injury group compared to the psychiatric group, but not disorientation to personal information/place. Relying on disorientation as an indicator of malingering, at least for mild head injured litigants, may underestimate its prevalence.
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J. HEMME & S. QUIRK. Evaluating the Utility of Using Cognitive Variables in Predicting Malingering.
The detection of malingerers seeking social security compensation is a significant social and assessment concern. Neuropsychologists are called upon to use cognitive assessment instruments to help identify individuals misrepresenting themselves. Malingering detection methods derived from the WAIS were compared in a sample of 120 individuals attempting to obtain social security disability income, half of whom were later judged to have been misrepresenting their psychological functioning during their assessment. Malingering status was determined by psychologists based on claimants' performance on the WAIS, clinical interviews, and diagnostic criteria from the Diagnostic and Statistical Manual–Fourth Edition (DSM–IV). It was hypothesized that malingerers would perform more poorly than the comparison group on short-term auditory memory for digits (Digit Span) while performing in the average range on measures assessing fund of general knowledge (Vocabulary). It was also hypothesized that differences between observed and predicted IQ (using Barona's demographic equation) would be larger for the malingering group than the comparison group. These hypotheses were not supported. Contrary to prediction, the honest group had a larger discrepancy between their Vocabulary and Digit Span scores. Observed IQ scores were the only reliable predictors of group membership (ω^2 = .20).
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L. COX, M. SEIDENBERG, M. PRIMEAU, C. CÁCERES, & J.L. WOODARD. Verbal and Nonverbal Memory In Combat-Related Posttraumatic Stress Disorder.
One of the most prominent symptoms of posttraumatic stress disorder (PTSD) is alteration in memory function. Neuroimaging studies of military veterans with PTSD have found that brain regions critically involved in memory functions, such as the hippocampus, are damaged by the chronically high levels of glucocorticoids secreted during the stress response, and have suggested that this may underlie the memory impairment observed in PTSD. However, there are also high rates of comorbidity with other psychiatric disorders (e.g., substance abuse) evident in combat-related PTSD that may be associated with hippocampal damage and related memory impairment. While verbal memory impairments are reliably observed in PTSD patients, less consistent findings are evident for nonverbal memory. Empirical evidence suggests that face and spatial memory tasks may be more sensitive to right temporal lobe dysfunction than figural tasks. This study used verbal memory measures from the Wechsler Memory Scale–Revised (WMS–R) and indices from the Faces in Space Test (FIST) to examine verbal and nonverbal memory function in Vietnam veterans with combat related PTSD (n = 15), veterans without PTSD but with a polysubstance abuse history (n = 18), and healthy control participants (n = 18). Results indicated that veterans with and without a PTSD diagnosis but with comparable polysubstance abuse histories demonstrated poorer verbal memory performance relative to healthy control participants. Significant group differences were not found for nonverbal memory. These findings suggest that the verbal memory deficits observed in combat-related PTSD may be associated with comorbid substance abuse rather than PTSD symptomatology.
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K. GROHMAN, K. DONNELLY, J. KLEINER, & J. STRANG. Memory and Olfactory Discrimination in Posttraumatic Stress Disorder.
Evolving conceptualizations of posttraumatic stress disorder (PTSD) have driven neurophysiological and neuroanatomical research to implicate the limbic system and its related structures in dysfunction of cognition and behavior. However, neuropsychological research that provides clinical correlates is still in its infancy, especially regarding frontal connections. This study explored differences in neuropsychological functioning of 22 Vietnam combat veterans with posttraumatic stress disorder (PTSD) to 20 Vietnam combat veterans without PTSD. Measures of hippocampal and orbito-frontal functioning were considered in the form of both immediate and delayed, visual and auditory memory; auditory new learning; working memory; and olfaction. This was assessed with the Wechsler Memory Scale–III, the University of Pennsylvania Smell Identification Test, and the Hopkins Verbal Learning Test–Revised. Individuals diagnosed with PTSD were less proficient in both immediate and delayed auditory and visual recall, auditory new learning of a word list, and olfactory discrimination. These deficits were not due to working memory or visual attention deficits. Differences were not found between the groups for cued recall or recognition tasks. Olfactory discrimination deficits were found in the PTSD group and were related to measures of auditory free recall. The findings of this study do not support the hippocampal hypothesis for memory dysfunction in PTSD. Instead, these data support the need to continue exploring the role of frontal connections within the limbic system.
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S. GONTKOVSKY, K. McSWAN, & G. SOUHEAVER. Cognitive Dissimulation Base Rates for Neurological Patients on the 21 Item Test.
Effective detection of neurocognitive dissimulation represents an important issue confronting clinical neuropsychologists. Factors to be considered in determining potential feigning of deficiencies have been reviewed recently by various authors and include the presence of an external motivating variable, inconsistencies between self-report data and other sources of information, and evidence of exaggerated performances on psychological measures. Over the past decade, the field has witnessed an emergence of psychometric instruments designed specifically to detect neurocognitive dissimulation. While these measures provide guidelines for probable identification of individuals suspected of malingering, limited data is available with respect to test performance base rates of neurologically-compromised patients without apparent motivation to feign cognitive impairment. This study was implemented to provide such data for 3 clinical populations on the 21 Item Test (Iverson, 1998). Subjects (N = 85) consisted of patients referred for comprehensive neuropsychological evaluation. Those individuals identified as being involved in forensic proceedings at the time of examination were excluded from participation. Subjects were classified into a seizure-disordered group, a heterogeneous brain-damaged group, or a pseudo-neurological control group. Analyses revealed the pseudo-neurological control group performed at a level better than the brain-damaged group but worse than the seizure-disordered group across all 4 indicators of the 21 Item Test. All groups performed at a level inconsistent with malingering. However, findings must be interpreted in light of a significant relationship, $p < .05$, that was found to exist between performances on Free Recall, Forced Choice, and Greatest Consecutive Misses and various demographic/cognitive variables.
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S. GONTKOVSKY & W. LEBER. Impact of Combat-Related Traumatic Stress on Attentional and Memory Processes.
Contemporary approaches to the conceptualization of post-traumatic stress disorder (PTSD) have reflected a growing interest in the contribution of information-processing, physiological, and psychobiological factors underlying such stress-related phenomena. Consequently, the neuropsychological manifestations associated with traumatic stress recently have gained prominence in the clinical literature. While investigations examining the neurocognitive sequelae of PTSD have yielded varying results, performance deficiencies have been documented across tasks of sustained attention, mental manipulation, initial acquisition, delayed recall, planning, organization, and judgment. Debate remains, however, as to whether the cognitive impairments observed commonly in such patients are the direct result of neurophysiological compromise or are exhibited purely as a consequence of emotional distress. This study examined the attentional, learning, and memory functioning of veterans with marked PTSD symptomatology relative to that of veterans with no evidence of PTSD symptomatology, controlling for exaggeration of emotional complaints. Despite a marked difference between endorsements on MMPI–2 measures of psychopathology, no significant difference was found to exist between group performances on tests of attention and immediate memory. A significant difference in scores was disclosed on multivariate analyses of delayed recall tasks; however, this difference was found to be negligible when PTSD patients with MMPI–2 validity profile configurations suggestive of extreme symptom exaggeration were excluded from analyses. Findings indicate that although veterans with PTSD exhibit markedly greater psychopathology relative to veterans free from PTSD symptomatology, comparable performances can be expected across measures of neurocognitive functioning, particularly under conditions controlling for probable feigning of complaints.
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S.E. O'BRYANT, L. ASHENDORF, & R.J. McCAFFREY. Correlations Among Measures of Malingering in a Sample of Litigants: A Cross Validation.
The increasing role of neuropsychologists in forensic cases has led to an explosion in the amount of research devoted to measures of symptom exaggeration/malingering. O'Bryant et al. (2000) examined the extent to which several of these commonly utilized techniques overlap with one another. The purpose of the present study was to cross validate those findings in a sample of 51 mild-to-moderate TBI litigants. Scores on the Test of Memory Malingering (TOMM), Rey 15-Item Test, and the validity scales of the Minnesota Multiphasic Personality Inventory (MMPI–2) were compared. The Rey-15 significantly correlated with TOMM trial 1 and trial 2 scores ($p < .05$). None of the MMPI–2 validity scale scores significantly correlated with the TOMM or the Rey-15. The results of these findings suggest that the MMPI–2 validity scales should not be used in isolation to assess for symptom exaggeration/malingering in TBI litigants.
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S.E. O'BRYANT, M. WEBER, M. CONSTANTINOU, L. ASHENDORF, & R.J. McCAFFREY. Performance Profiles of Symptom Exaggeration on the Memory Assessment Scales: A Cross Validation.
Due to the increasing role of neuropsychologists in the courtroom, there has been an increase in research devoted to the identification of possible malingering. Much of this research has focused on already established neuropsychological testing instruments. The purpose of this study was to cross validate the findings of O'Bryant et al. (2001) regarding possible performance patterns indicative of symptom exaggeration/malingering on the Memory Assessment Scales (MAS) in a sample of 51 mild-to-moderate head injured litigants. Subjects were divided into 2 groups based on their scores on the Test of Memory Malingering (TOMM) and/or the Rey Fifteen Item Memory Test (REY–15). Group 1 consisted of subjects suspected of symptom exaggeration (TOMM trial 2 score < 45 or REY–15 score ≤ 9) and Group 2 consisted of those not suspected of symptom exaggeration (TOMM trial 2 score ≥ 45 or REY–15 > 9). First, the group mean scores of both groups on all MAS variables were compared to the statistical norms. Next, the groups were compared to one another on all MAS variables. Group 1 scored significantly lower than the statistical norms on all MAS variables, which was not the case for Group 2, and Group 1 scored significantly lower than Group 2 on all MAS variables. These results replicate the findings of O'Bryant et al. (2001) indicating that the MAS, when used in conjunction with other tests, may prove useful in the detection of possible malingering.
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A. BOLLICH, M. McCLAIN, C. DOSS, & W. BLACK. Inconsistent Memory Test Performance and Malingering.
The validity of neuropsychological test results, particularly in forensics, is determined, in part, by the ability of the examiner to accurately estimate the patient's effort in test performance. The goal of this study was to compare performance across 2 types of verbal memory as a means of distinguishing suspected malingerers (SM) and probable nonmalingerers (NM). A consecutive series of litigating patients referred for neuropsychological evaluation were selected ($N = 112$). A clinical decision was made on patient malingering potential based on the senior author's blind review of each patient's medical history, cognitive test data, and emotional functioning, excluding symptom validity test results. Patients were divided into 2 groups: SM ($n = 38$) and NM ($n = 74$). The patients' performance on the short-delay free-recall trial of the Rey Auditory Verbal Learning Test (RAVLT) was compared to their performance on the recognition trial measure, reflecting both true and false positives (d'). A mixed ANOVA was used to compare the two groups, SM and NM, with Test (free-recall *vs.* recognition) as the repeated measure. The results were significant for Test ($p < .001$) and the Group $\times$ Test interaction ($p < .001$). Both groups demonstrated poorer performance on the recognition trial as compared to the free-recall trial, relative to normative data. Notably, the difference between the two groups varied significantly across the 2 tests (i.e., the SM subjects showed a significantly steeper negative slope compared to the NM subjects). The inconsistency in memory test performance illustrated by these results should be considered a useful clinical tool in determining the presence of malingering.
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K. SULLIVAN. Faking of Neuropsychological Tests: Can We Deter Malingerers?
In neuropsychological settings "faking-bad" for financial gain in compensation cases involving claims of disturbed memory or other cognitive abilities may occur. This can be costly for the community, and may result in incorrect diagnosis or treatment for the individual. Previous research on malingering in neuropsychological settings has typically focussed on developing or refining methods of detecting malingerers. In this paper, a relatively new approach to malingering research is presented focussing on the potential deterrents against malingering. Specifically, the results of 2 experimental studies will be presented. Both studies use an analogue research design to test predictions from deterrence theory. In the first study, the effects of providing 100 simulators with a warning that faking may be detected are explored in relation to performance on a clinical memory task (RAVLT). In the second study, warning effects on several measures of subjective complaints are presented, based on data from 50 volunteers (GHQ-30, Neuropsychological Symptom Checklist, and Depression, Anxiety, and Stress Scales). Consistent with previous research, results from both studies show the measures we used are vulnerable to faking and

warning participants against malingering did not alter their performance. Ethical issues in relation to the use of warnings in clinical neuropsychological assessments are discussed.
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Poster Session 5/12:00–2:30 p.m.

DRUGS AND TOXINS

K. TUCKER, T. KOSTEN, J. BROWNDYKE, J. BEAUVAIS, & C. GOTTSCHALK. Response Characteristics of Cocaine Abusers on a Decision-Making Task.
This study examined the response latency of cocaine abusers on a computerized decision-making task. The Iowa gambling task presents the dilemma of choosing between high immediate rewards with large negative consequences (bad decks) or smaller immediate benefits with ultimately greater cumulative profits (good decks). Previous studies have shown that cocaine abusers obtain significantly worse gambling-task scores than normal subjects. It is unclear whether part of their difficulty is related to impulsive selection of cards. Identification of their response style might offer insight into the etiology of their impairment. An impulsive pattern might be interpreted as a reflection of personality characteristics among cocaine abusers without history of neurological disturbance. Whereas, a pattern of delayed response latencies might be more suggestive of cognitive dysfunction. Results of the current study showed that with a mean gambling task score of 19, cocaine abusers fell within the impaired range. There was a significant positive correlation between response latency and number of bad cards selected, indicating that poorer performers actually took longer to make choices. This did not seem to be an artifact of slowed motor speed or depressive symptoms, as scores for these variables were not associated with gambling task performance. The results of this study suggest that impaired performance on the decision-making task may be related to cognitive dysfunction, rather than simply to an impulsive response style. The discussion describes implications for treatment and possible etiologies of cognitive dysfunction, including cerebral hypoperfusion secondary to cocaine abuse.
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H.L. ROSENBERG, K.W. SAX, M.P. DELBELLO, C.M. ADLER, P.K. SHEAR, & S.M. STRAKOWSKI. Cognitive Effects of D-Amphetamine Exposure.
Research on the acute cognitive effects of amphetamine exposure suggests that the drug has an enhancing effect on vigilance. It has been assumed that other cognitive abilities are similarly enhanced by amphetamines, although there is not clear empirical evidence to support this contention. The goal of the present study was to evaluate the presence of acute neuropsychological changes in the cognitive domains of verbal fluency, visuomotor abilities, and selective attention after a dose of d-amphetamine. Sixty healthy participants were randomly assigned to drug or no drug conditions, receiving an oral dose of either d-amphetamine in the amount of 0.25 mg/kg, or a matched placebo. The participant and rater were both blind to group assignment. The following cognitive measures were administered 2 hours apart to capture baseline and peak effects: a modified version of the Controlled Oral Word Association Test, the Grooved Pegboard Test, and the Stroop Color and Word Test. A series of ANCOVAs was run to examine potential group differences on each measure at the follow-up assessment, after controlling for baseline performance. Significant performance enhancement in the amphetamine group was found for Grooved Pegboard performance with the nondominant hand ($p < .04$); no other significant drug effects were identified. This study indicates that the acute cognitive effects of d-amphetamine may be quite subtle, although there is evidence of a possible enhancing effect of the drug on fine motor coordination.
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S. KHAVANDGAR, H. HOMAYOUN, A. TORKAMAN-BOUTORABI, & M.R. ZARRINDAST. Effects of Adenosinergic System on Morphine-Induced Amnesia and Morphine State of Memory in Mice.
Acute administration of morphine (5 mg/kg, i.p.) 30 min before passive avoidance training leads to significant reduction of 24 hr step-down latency in mice. Administration of morphine 30 min before testing restores the memory to the control level, a phenomenon called "morphine state of memory." We examined the effects of pre-test administration of adenosine receptor agonists and antagonists on morphine-induced amnesia and morphine state of memory in mice, using a single-trial step-down paradigm. Morphine-induced amnesia was dose-dependently reversed by pre-test morphine (0.5, 1, 3, and 5 mg/kg). Both nonspecific adenosine receptor antagonist theophylline (2.5, 5, 12.5, and 25 mg/kg) and specific adenosine A_1 receptor antagonist 8-phenyltheophylline (0.5, 1, and 2 mg/kg) at doses which did not alter morphine-induced amnesia, inhibited the restoration of memory by pre-test morphine (5 mg/kg). Adenosine A_1 receptor agonists N^6-cyclohexyladenosine (CHA, 0.1, 0.3, and 0.5 mg/kg) or N^6-phenylisopropyladenosine (R-PIA, 0.03, 0.1, and 0.2 mg/kg) at higher doses used and Adenosine A_2 receptor agonist 5′-N-ethylcarboxamidoadenosine (NECA, 0.001, 0.005, 0.01, and 0.05 mg/kg) at all doses used decreased morphine-induced amnesia. Administration of CHA, R-PIA, or NECA prior to pre-test morphine injection, significantly potentiated the restoration of memory induced by a lower dose of morphine (1 mg/kg). It is concluded that activation of the adenosinergic system, probably through both A_1 and A receptors, can reverse morphine-induced amnesia and is involved in morphine state of memory.
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H. HOMAYOUN, S. KHAVANDGAR, & M.R. ZARRINDAST. Effects of Adenosine Receptor Agonists and Antagonists on Pentylenetetrazole-Induced Amnesia.
The effect of adenosine agents on amnesia induced by pentylenetetrazole (PTZ) was examined in mice. Post-training administration of PTZ (50 and 60 mg/kg) disrupted 24-hr retention of a single trial passive avoidance task. The adenosine receptor antagonists theophylline (2.5–25 mg/kg) and 8-phenyltheophylline (8-PT, 0.5–2 mg/kg) administered 30 min before and just after training at does which did not affect retention, reduced the amnestic effect of PTZ in a dose-dependent manner. Post-training administration of the adenosine A_1 receptor agonists N^6-cyclohexyladenosine (CHA, 0.1 and 0.5 mg/kg) and N^6-phenylisopropyladenosine (R-PIA, 0.03 and 0.1 mg/kg), but not the adenosine A_2 receptor agonist 5′-N-ethylcarboxamidoadenosine (NECA, 0.01 and 0.001 mg/kg), impaired retention. Nonamnestic doses of CHA and R-PIA potentiated the disruption induced by a lower dose of PTZ (40 mg/kg). NECA did not induce any response in this respect. It is suggested that an adenosine A_1 receptor mechanism is involved in amnesia induced by PTZ.
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M. CHERNER, R.K. HEATON, R. GONZALEZ, J. RIPPETH, C. CAREY, I. GRANT, & THE HNRC GROUP. Exposure to Methamphetamine and Neuropsychological Functioning.
Methamphetamine (meth) is a central nervous system stimulant that leads acutely to increases in extracellular dopamine (DA), with possible damage to terminals of DA containing neurons. The effects of methamphetamine (meth) use on neuropsychological (NP) functioning were measured in 55 meth dependent study participants who had been abstinent for at least 3 weeks prior to testing. *Method:* Lifetime meth dependence was established using the SCID–IV substance use disorder modules. Ss were ex-

cluded if they met dependence criteria for other substances. Cognitive status was assessed with a comprehensive NP battery. Impairment was determined using blind clinical ratings based on demographically corrected T-scores, both for overall impairment and for impairment in 6 domains of functioning. Exposure to meth was measured by retrospective report as quantity × frequency × duration for lifetime use as well as for use in the previous 12 months. *Results:* Amounts of reported lifetime exposure to meth were not related to NP functioning in any ability domain. Degree of meth use in the previous 12 months correlated significantly with motor functioning only ($r = .31$, $p < .02$). *Conclusions:* While the lack of associated between meth use and other NP abilities is surprising, the dose-related effect on motor impairment is consistent with disturbance of the dopaminergic system.

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C. CAREY, R.K. HEATON, T. MARCOTTE, D. J. MOORE, J. RIPPETH, R. GONZALEZ, M. CHERNER, I. GRANT, & THE HNRC GROUP. Brief Neuropsychological Assessment for the Detection of HIV-Related Cognitive Impairment.

While the most accurate approach for detecting and characterizing HIV-related neurocognitive impairment involves assessment with a comprehensive neuropsychological (NP) test battery, lengthy batteries are at times difficult to administer in particular research and clinical settings. This study sought to develop a brief and valid screening battery by determining the sensitivity and specificity for 7 NP measures representing the ability areas most likely affected by HIV infection. The measures were selected from a larger NP battery administered to 303 HIV seropositive (HIV+) and 93 HIV seronegative (HIV−) subjects (*M* age = 39.0, *M* education = 13.1). The 7 measures were paired in all possible combinations ($n = 19$). Test performance was classified as impaired if demographically corrected *T*-scores fell below 40 for both tests in the pair, or below 35 for one test to account for the relative rarity of the event. Using blind clinical ratings of NP protocols from the full battery as the "gold standard" (impaired or unimpaired), performance on the Hopkins Verbal Leaning Test–Revised (HVLT–R) and the first (slowest) series of the Paced Auditory Serial Addition (PASAT–50) produced an overall diagnostic accuracy rate of 84%, demonstrating the highest combination of sensitivity (74%), specificity (90%), positive predictive power (81%), and negative predictive power (85%). Additionally, *T*-scores from both tests predicted 56% of the variance in a deficit summary score of the comprehensive battery. Results suggest that the HVLT-R/PASAT-50 combination may serve as a valid screening device to identify subjects with potential HIV-related NP impairment who could benefit from more extensive NP examination.

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M. HORNER, R. MACKIN, L. FLORES, & R. HARVEY. Relationship of Executive Functions to Social and Occupational Problems in Cocaine Abusers.

While a growing literature has addressed neurocognitive dysfunction in chronic cocaine abusers, few studies have examined the relationship of these deficits to patients' social or occupational functioning. As part of a larger study, 17 substance abuse outpatients who met DSM–IV criteria for cocaine abuse or dependence were administered a comprehensive neuropsychological examination after at least 2 weeks of abstinence, as well as the Addiction Severity Index, a structured interview assessing functioning in various domains. Pearson correlations were calculated between neuropsychological test scores and specific ASI indices of social and occupational functioning. After Bonferroni correction, fewer errors on the Stroop Color-Word condition were associated with fewer lifetime citations for major driving violations ($r = .81$, $p < .001$), and higher verbal fluency scores were associated with greater length of full-time employment ($r = .83$, $p < .001$). Several other relationships did not remain significant after Bonferroni correction: Better Stroop Interference scores were associated with fewer lifetime convections ($r = -.74$, $p < .01$); lower percent of perseverative errors on the Wisconsin Card Sorting Test was associated with fewer lifetime citations for major driving violations ($r = .71$, $p < .01$); and higher WAIS–R Similarities scores were associated with lower overall ratings of employment problem severity ($r = -.71$, $p < .01$). Measures of memory, attention, and visuoconstruction were not significantly correlated with social or occupational variables. These results suggest that, among cocaine-abusing patients seeking treatment, indices of executive functions are specifically related to aspects of social and occupational functioning.

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M.R. ZARRINDAST & A. TORKAMAN-BOUTORABI. Effects of Imipramine on the Expression and Development of Dependence on Morphine in Mice.

Central catecholamines seem to have an important role in the expression of the somatic signs of withdrawal or abstinence syndrome of opioids. Imipramine also inhibits reuptake of monoamine. In the present study, effects of imipramine and/or adrenoceptor agents on the expression and development of dependency to morphine in mice were investigated. Morphine sulfate was injected subcutaneously (s.c.) 3 times daily (50, 50, and 75 mg/kg) for 3 days in order to induce dependency on morphine. Abstinence was precipitated by a subcutaneous injection of naloxone (4 mg/kg). The number of jumps was recorded immediately after injection of naloxone over a 30-min period. Administration of imipramine (10–60) mg/kg) before naloxone increased the number of jumps. Injection of clonidine (0.1 mg/kg) or phenylephrine (4 mg/kg) neither altered naloxone-induced jumping by themselves nor influenced imipramine response. While yohimbine (4 mg/kg) increased the jumping by itself and decreased imipramine effect, Prazosin (1 mg/kg) did not induce any response. In the second set of experiments, the drugs were injected alone or in combination during development. Imipramine (10–40 mg/kg) increased development of dependency and showed more jumping. Both yohimbine and prazosin decreased the effect of imipramine. Clonidine did not influence imipramine effect. Phenylephrine was lethal in combination with imipramine. It is concluded that an alpha-adrenoceptor mechanism may modulate development and expression of naloxone-induced withdrawal signs in mice.

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K. BOOKER, T. STRICKLAND, B. ALPERSON, E. SAXTON, & K. MASON. Cerebral Perfusion and Neuropsychiatric Disturbance in Abstinent Cocaine Abusers.

Cocaine abuse has been linked to cerebral vasculitis, vasospasms, and marked cerebral perfusion anomalies. Extant literature reveals cocaine-induced hypoperfusion in specific brain regions including bi-frontal and bi-temporal areas with associated neurocognitive and neuropsychiatric deficits. Although depression is a common consequence of cocaine withdrawal, likely secondary to dopamine depletion, depressive symptoms often persist beyond detoxification. Moreover, a relationship between cerebral hypoperfusion and neuropsychiatric symptomatology may also exist. Given that cocaine abuse precipitates cerebral blood flow anomalies and mounting evidence suggests a possible link between hypoperfusion and neuropsychiatric disturbance, diminished prefrontal blood flow may be associated with persistent depression in abstinent cocaine abusers. The purpose of this study was to evaluate the relationship between cerebral perfusion in frontal brain regions and depression, utilizing Xenon-133 absolute cerebral blood flow (ml/100g/min) and an assessment of depression. Twenty subjects (mean age = 32.7, mean abstinence = 6.3 months) were administered the Beck Depression Inventory and received Xenon-133 to quantitate absolute cerebral blood flow in 4 brain regions, including left frontal middle, right frontal middle, left frontal medial, and right frontal medial. Results revealed hypoperfusion in the right frontal middle region was associated with significantly higher depression scores $r = -.50$. Though nonsignificant, rCBF decrements in remaining brain regions was associated with higher depression scores as well, with correla-

tions ranging from $r = -.13$ to $-.38$. These data suggest that chronic cocaine abuse may result in frontal perfusion anomalies and associated neuropsychiatric disturbance that may persist well into abstinence.
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K. LISDAHL MEDINA, P.K. SHEAR, & J. SCHAFER. Memory Functioning in Polysubstance Dependent Women.
Numerous studies have demonstrated significant neuropsychological impairment, including verbal and visual memory, among polysubstance abusers. Unfortunately, the vast majority of studies on polysubstance abuse have utilized primarily male participants; therefore the specific neuropsychological effects of polysubstance abuse on women are relatively unknown. Further, there is strong evidence that sex differences exist in the effects of drug abuse on memory functioning, which suggests that results obtained primarily from men cannot necessarily be generalized to women. The goal of the present study is to examine the effects of polysubstance dependence on women's verbal and visual memory ability. Data were collected from 164 women (including 53 controls and 111 women who met current DSM–IV dependence on two or more drugs) who were similar in age, ethnic identification, education, levels of depression, and verbal ability. A series of multiple regressions were run to test whether group membership significantly predicted performance on the Benton Visual Retention Test and the California Verbal Learning Test after controlling for age, history of loss of consciousness, level of education, ethnic identification, and length of abstinence. The primary results indicated that the polysubstance dependent women had significantly poorer verbal learning and memory ability ($p < .006$) and discriminability ($p < .03$) compared to the controls, while no differences were found in visual memory ability. The results confirm that polysubstance dependence is associated with verbal learning and memory deficits among women.
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S. LEACH, M.W. HAUT, A. DUCATMAN, P. McCABE, B. LEVIN, & N. SCHNEIDERMAN. Effects of Solvent Exposure on Working Memory.
Solvents have been demonstrated to produce deficits with attention and processing, 2 key elements for working memory. The purpose of this study was to investigate the effects of chronic solvent exposure on working memory functions. Twenty subjects chronically exposed to solvents and 20 age and education matched, healthy controls served as the participants. Subjects with solvent exposure were otherwise healthy. Subjects were administered self-ordered pointing tasks for both verbal and visual information. The tasks increased in difficulty by varying amount of information to be processed and potential for organization. The results of this study demonstrated that subjects with a history of chronic exposure to solvents, relative to the controls, had increased error rates and failure to apply an organizational strategy, but no difference in working memory span. These results were independent of depressive symptomatology. These findings are consistent with deficits in executive functioning in patients with chronic solvent exposure.
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L. MORROW, H. NEEDLEMAN, K. METHENY, C. McFARLAND, & D. SANDSTROM. Cumulative Lead Exposure and Neuropsychological Function.
Lead continues to be a major occupational toxin. While blood lead levels (BLL) estimate recent exposure, they don't measure cumulative exposure or body burden. Bone lead concentration—measured with X-ray fluorescence (XRF)—is the best way to estimate cumulative lead exposure. The current study is a longitudinal follow-up of a group of workers with past and current occupational exposure to lead (average years at lead battery plants = 27.0), and nonexposed controls. Subjects were initially tested 20 years ago and little difference was found between the groups. At that time, only BLL were taken. To date, we have reassessed 35 subjects on measures of neuropsychological function, and BLL and additionally collected XRF. Preliminary results show significantly higher BLL ($p < .001$) and XRF ($p < .05$) in exposed workers, as well as poorer performance on most neuropsychological measures, though only visual delayed memory and verbal delayed memory were significant ($p < .05$). Within the lead-exposed group, correlations were computed between lead measures and neuropsychological performance, controlling for age. Higher bone lead was associated with poorer performance on a number of measures—verbal learning, symbol-digit learning, digit symbol substitution, incidental recall, block design, visual memory, and delayed symbol-digit learning (rs ranged from $-.42$ to $-.75$). Correlations between BLL and neuropsychological test scores were less consistent but in the expected direction. These findings indicate that cumulative lead exposure, as indicated by higher concentrations of bone lead, is related to poorer neuropsychological function in occupationally exposed workers.
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B.C. SCHWEINSBURG, M. J. TAYLOR, O.M. ALHASSOON, A.D. DAGER, S.F. TAPERT, T.L. PATTERSON, & I. GRANT. Spectroscopy and Cognitive Functioning in Alcoholics with Withdrawal Seizures.
Neuropsychological (NP) and MR imaging investigations have revealed that the brain may be sensitive to alcohol withdrawal seizures. However, the cellular correlates and NP consequences of withdrawal seizure-associated brain damage have not been well characterized in recovering alcoholic individuals. Proton magnetic resonance spectroscopy (MRS: PRESS, TE = 35 ms) and a comprehensive NP battery were used to compare brain metabolism and cognitive abilities in 10 recently detoxified alcoholics with a history of at least one withdrawal seizure (RDA–S: age = 39.8), 10 RDA with no history of alcohol-related seizures (RDA: age = 39.9), and 11 nonalcoholic controls (CON: age = 41.8). We predicted that RDA–S would display reductions in relative amounts of *N*-acetylaspartate (NAA), a marker of neuronal integrity, in frontal lobe gray matter (FGM) and frontal lobe white matter (FWM) when compared to the other groups. In addition, RDA–S were expected to have greater difficulties in NP domains of executive functioning and novel learning ability. The groups were equated on age, education, and an estimate of premorbid verbal functioning, and the alcoholic groups had similar drinking histories. Pairwise comparisons revealed RDA–S had significantly lower NAA/creatine in FWM compared to RDA ($p = .05$) and CON ($p = .01$). The groups had comparable levels of NAA/creatine in the FGM region of interest. RDA–S had greater difficulties on tests of novel learning compared to CON ($p = .001$) and RDA ($p = .07$), and the groups had similar performances on other measures of NP functioning. The results suggest that brain white matter axons and learning efficiency may be particularly sensitive to the effects of alcohol and withdrawal seizures.
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C.L. ARMSTRONG & J. CUNNINGHAM. Developmental Effects of Carbon Monoxide (CO) Poisoning.
Children are at high risk for carbon monoxide poisoning through fetal and post-natal exposure to maternal cigarette smoking, and through other vectors (as a motor vehicle passenger, a resident of a home with combustible fuel heat, exposure to chemical fumes). Children are at particular risk because of their small size and reduced pulmonary transport of CO due to immaturity. An earlier study at Children's Hospital of Philadelphia showed that half of the children admitted to the Emergency Room for flu-like symptoms and some means of exposure also had elevated carboxyhemoglobin levels. This paper reviews the animal and human studies of CO exposure and effects on behavior, in order to understand when CO exposure is most damaging, and what are the related risk factors. Integration of studies of outcome from exposure at different developmental phases, in both small animals and humans, provides evidence for both the timing and physiological mechanisms of the damaging effects upon the brain. The developmental phase of exposure appears to be a critical determinant of

significant mental impairment in children, and the temporal course of the developmental disturbance is different than in other cases of chemical toxicity. A case is also presented in whom low-level, chronic CO exposure began prenatally and occurred in early childhood, and for whom effects upon neuropsychological functioning were demonstrated by serial assessments at ages 4 and 6 years. In this case, the neurobehavioral effects upon functioning were widespread though partially selective, without resulting in autism or a typical learning disability type. Both cognitive and adaptive functioning are described.

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Poster Session 5/12:00–2:30 p.m.

OTHER ILLNESS

M. WILLIAMS, A. SKLAR, P. SHAH, M. SOLLMAN, R. BUERIGHT, & P. DONOVICK. Temporal Effects of Dialysis on Cognitive Functioning in End-Stage Renal Disease Patients.

Although dialysis has been shown to improve cognitive deficits resulting from uremia, little is known about potential temporal variations in cognitive measures between hemodialysis treatments. We studied dialysis patients for possible fluctuations in memory and attention using a repeatable neuropsychological battery. Twenty patients undergoing hemodialysis (HD) (10 females and 10 males, *M* age = 54.6) on a thrice weekly schedule were tested on various measures of memory and attention at time intervals of 1, 24, and 67 hours post-hemodialysis. For purposes of comparison we also studied 10 patients on continuous ambulatory peritoneal dialysis (CAPD) (5 females and 5 males, *M* age = 45.1) at identical time intervals. Results revealed that CAPD patients demonstrated an overall stable performance on memory and attention measures. However, patients undergoing hemodialysis exhibited significant impairment in auditory memory for both immediate and delayed recall, with greatest impairment occurring at 67 hrs post-hemodialysis. Hemodialysis patients also demonstrated a significant reduction in attention over the 3 test periods, with greatest impairment seen at 67 hrs post-dialysis. An inverse relationship was found between performance on measures of cognition and levels of post-dialysis fatigue. We conclude that CAPD patients demonstrated cognitive stability, whereas HD patients show temporal fluctuations in cognitive performance that does not appear to be induced by post-dialysis fatigue.

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M. KELLY, L. RYAN, J. SPECTOR, D. WARDEN, M. BAGGETT, J. McCONNELL, & V. INGRAM. Heat Stroke Can Cause Long-Term Neuropsychological Impairment.

Neurological symptoms are ubiquitous at the onset of heat stroke and permanent neurological sequelae including cerebellar syndromes, mental disorders, hemiplegia, peripheral neuropathy, and flaccid quadriplegia have been reported. To date, information about the neuropsychological sequelae of heat stroke is limited to a series of 5 case studies. Existing case studies provide limited or no longitudinal follow-up of neuropsychological status. We extend this literature by reporting neuropsychological profiles of 5 young adult, previously healthy military service members who suffered exertional heat stroke during supervised exercise. All patients underwent comprehensive neuropsychological batteries including tests of intellectual functioning, language, attention, spatial ability, executive functioning, learning, and memory though the particular tests employed varied from patient to patient. Four patients were evaluated within the first 3 months postinjury and again in follow-up at about 12 months post-injury or longer. One patient demonstrated a normal neuropsychological profile on initial testing about 3 months post-injury and was not followed further. Three of the other 4 patients showed both early and late substantial neuropsychological impairment precluding return to full active duty status, while one patient exhibited subtle impairment on initial testing and a normal profile on follow-up. There was no single unique neuropsychological profile that characterized this group of patients, and in 2 cases there were indications of significant long-term neuropsychological impairment in spite of normal neuroimaging. Findings are discussed in relation to available literature relating to the neuropathology, neurological sequelae, and potential pathophysiological mechanisms of neuropsychological impairment in heat stroke patients.

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D. BEEBE & D. GOZAL. Obstructive Sleep Apnea and Daytime Functioning: A Prefrontal Cortical Model.

Obstructive sleep apnea (OSA) is accompanied by significant daytime cognitive and behavioral deficits that extend beyond simple sleepiness. We propose a causal model by which to understand these psychological effects among patients who have not experienced frank strokes. The model proposes that OSA-related sleep disruption and blood gas abnormalities prevent sleep-related neural restoration, and further induce chemical and structural central nervous system cellular injury. This, in turn, leads to prefrontal cortical (PFC) dysfunction, manifested by executive dysfunction and maladaptive daytime behaviors. Although previous studies have thus far linked OSA to cognitive dysfunction, we further advance that the PFC is differentially sensitive to OSA-related disturbances. Furthermore, preliminary data also suggest neurochemical and structural aberrations in individuals with OSA that may differentially occur in the PFC. PFC dysfunction is also highly likely based on its unique role in sleep and on the specific cognitive "footprint" of OSA. The executive system appears to be particularly impaired in untreated OSA, and is most likely to show persistent deficits despite appropriate medical treatment. The proposed model (1) accounts for the specific neuropsychological phenotype associated with OSA, (2) accommodates developmental components of this phenotype, (3) bridges the gap between physical and psychological phenomena, (4) suggests mechanisms by which the nocturnal disorder might have daytime effects, (5) is empirically testable, (6) generates new research hypotheses, and (7) has practical implications. The model is intended to act as a catalyst for future research and as a preliminary guide for clinicians.

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R. HILSABECK, M. CARLSON, B. ZIEGLER, T. HASSANEIN, & W. PERRY. Cognitive Complaints and Neuropsychological Functioning in Chronic Hepatitus C.

Introduction: Cognitive difficulties and the psychiatric symptoms of depression, anxiety, and fatigue are often reported by patients with the hepatitis C virus (HCV). We explored the relationship of self-reported cognitive problems and psychiatric symptoms to performance on neuropsychological tests. We hypothesized that cognitive complaints and psychiatric symptoms would be correlated with performance on neuropsychological tests. *Method:* Participants were 49 patients (67% male; 71% Caucasian) with chronic HCV not receiving antiviral therapy. Average age was 46.6 years ($SD = 7.3$), and average education was 13.1 years ($SD = 2.4$). Participants completed a 4-item version of the Medical Outcomes Study (MOS) Cognitive Scale, a Likert scale ranging from 4 (poor cognitive functioning) to 24 (good cognitive functioning). Participants also completed Digit Cancellation (DC), Trail Making Test (TMT), Symbol Digit Modalities Test (SDMT), a modified version of the Rey Complex Figure (RCF), Beck Depression Inventory–II (BDI–II), Beck Anxiety Inventory (BAI), and Multidimensional Assessment of Fatigue (MAF) scale. *Results:* HCV-infected patients obtained an average MOS cognitive score of 16.2 ($SD = 5.3$). Cognitive complaints were significantly correlated to DC ($r = -.48$; $p = .001$) and SDMT ($r = .36$; $p = .01$) and to BDI–II, BAI, and MAF ($r = -.59$, $-.57$, and $-.57$, respectively; $p < .001$). Cognitive complaints

were not significantly correlated with age, education, gender, ethnicity, or parameters of hepatic disease severity. *Conclusion:* Complaints of cognitive difficulties by HCV-infected patients are related to both psychiatric symptomatology and performance on neuropsychological tests.
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B. CANNON. Neuropsychological Functioning Pre/Post Craniopharyngioma Removal in an Adult.
Craniopharyngiomas often are considered to be brain tumors of childhood. There are a few reports of adult cases, but limited neuropsychological functioning data, particularly presurgery. Reported here is the case of a 32-year-old married woman with a Master's degree in education. Initial symptoms of memory difficulty were misdiagnosed as depression by her family doctor. Anterograde memory disturbance worsened and confabulation began, similar to Korsakoff's syndrome. Family sought a second medical opinion. MRI of the brain revealed a suprasellar craniopharyngioma. Neuropsychological assessment was conducted before surgical removal of the tumor and 1 month post. Prior to surgery, learning/memory, visual scanning, motor speed/fine motor coordination, and abstract reasoning were severely impaired. Visual organization showed moderate impairment and language and arithmetic skills, although low average, were lower than estimated premorbid levels. There was an overall deterioration of intellectual capacity. Behavior reflected perseverative tendencies and a detached, indifferent demeanor. Personality changes from premorbid state also were reported by family, although no MMPI clinical scales were significantly elevated. Areas of relative preservation included general information, vocabulary, and knowledge of social convention. Following surgery, all areas previously impaired were at least average. Verbal memory was superior, with slightly lower performance on visual memory tasks. Clinical presentation was dramatically improved. The probable role of involved neuroanatomical structures is discussed (i.e., mammillary bodies).
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J. EVANS, T. VENTURA, A. ROTH, M. KOVACS, & K. MILLER. A Longitudinal Study of Cognition as a Function of Treatment in Breast Cancer.
Recent work has suggested that the treatment of breast cancer may lead to cognitive impairments in several domains of function. Specifically, there is some suggestion that the implementation of adjuvant chemotherapy may lead to deterioration of cognitive performance that may persist after treatment has ended. Twenty-seven chemotherapy and 11 breast cancer patients not receiving chemotherapy were assessed prior to beginning treatment and again at follow-up (average length of follow-up 10 months), as part of a longitudinal study to examine the effects of adjuvant chemotherapy on cognitive abilities. Preliminary results found no significant differences between the 2 groups at baseline on measures of learning, executive functioning, or processing speed. However, both groups exhibited moderate levels of depression and anxiety. Among chemotherapy patients, however, neither depressive nor anxious symptoms were related to cognitive performance. Follow-up data on a subsample of patients (n = 19) found no significant differences in neuropsychological test performance as a function of treatment. Although very preliminary, these results find little evidence of a detrimental effect of adjuvant chemotherapy among women with breast cancer.
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C. ANDERSON-HANLEY, M. SHERMAN, R. RIGGS, & B. COMPAS. Possible Cognitive Effects of Systemic Treatment for Cancer: A Meta-Analysis.
A meta-analysis was conducted using the data from 37 independent samples examining the possible cognitive effects of systemic treatment for cancer (e.g., chemotherapy or hormonal therapy). *Results:* Varied results have been reported in the medical and psychological literatures using 3 primary means of evaluating the possible impact: *Method 1 (pre- and post-treatment performance):* Most studies reported no significant differences. Nonsignificant results outnumbered declines or improvements across most domains (attention, verbal memory, visuospatial memory, verbal fluency, motor, and executive function), with the exception of information processing speed). *Method 2 (post-treatment performance vs. normative data):* Results varied widely (0 to ≤ -3 *SD* below the norm). Verbal memory, visuospatial memory and executive function had the most consistent results (-1.5 *SD*). *Method 3 (post-treatment performance vs. controls):* Results varied widely. Visuospatial memory executive function, and information processing speed had the most consistent results (-1 *SD*). *Conclusions:* There is great variability in the literature regarding the possible cognitive impact of systemic treatments for cancer. A number of factors may be contributing: different methods for assessing change, great variability across studies in site of cancer, type and duration of treatment, etc. It is premature to conclude that systemic treatments for cancer will uniformly produce significant changes in cognitive function. Clearly, more well-controlled research is needed to clarify for whom, when, and under what conditions cognitive changes will most likely accompany systemic treatments.
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J. PARRISH, J. SHUCARD, D. SHUCARD, D. McCABE, R.H.B. BENEDICT, & J. AMBRUS, Jr. Working Memory Deficits in Systemic Lupus Erythematosus.
The Paced Auditory Serial Addition Test (PASAT) is a continuous performance task that is a sensitive measure of working memory and cognitive processing speed. Fisk and Archibald (2000) hypothesized that a "chunking" strategy can be used by patients to obtain correct responses without performing the task according to instructions, thereby lowering the processing demands of the task. Chunking occurs when patients skip items intermittently in order to chunk numbers into manageable units, while dyads are defined as correct consecutive responses. In Fisk and Archibald's (2000) study comparing multiple sclerosis (MS) and controls, chunking was found in both the MS and control groups, however it was significantly greater in MS than controls at the slowest presentation rates (2.4, 2.0 sec pacing). In the present study, we examined performance on the PASAT (2.4, 2.0 sec pacing) in a sample of 45 patients with systemic lupus erythematosus (SLE) and 27 healthy adult controls matched on age, sex, education, and IQ. SLE patients made significantly fewer correct responses at the 2.0 sec presentation rate ($p < .05$), and their percentage of dyads was significantly lower than that of the control group for both presentation rates (2.4 sec pacing, $p < .05$; 2.0 sec pacing, $p < .01$). These findings indicate that SLE subjects chunked responses more often than healthy adults, which suggests that individuals with SLE have deficits in working memory and cognitive processing speed similar to that seen in MS.
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R. SCHEIBEL & C. MEYERS. Depression and Cognitive Impairment as Symptoms of Interferon Neurotoxicity.
Depression is a side effect of interferon alpha (IFN-α) and pre-existing affective symptoms may be a risk factor for the development of depression during treatment. In addition, interferon-induced depression may be responsible for cognitive symptoms. The present study used the Depression (D) scale of the Minnesota Multiphasic Personality Inventory to assess 18 adults receiving IFN-α for chronic myelogenous leukemia. Because 9 patients also received cytosine arabinoside or hydroxyurea, data were analyzed using a mixed design examining Time (pretreatment *vs.* on-treatment) and Protocol (IFN-α alone *vs.* combination therapy). The main effect of Time was significant ($M_1 = 61.2$, $SD_1 = 11.2$; $M_2 = 68.5$, $SD_2 =$

14.6; $p < .012$), but there was no Time × Protocol interaction. Change scores were calculated by subtracting pretreatment from on-treatment scores. Depression scale change scores were correlated with changes on the Trail Making Test (TMT) Part B (rho = −0.56, $p < .017$), but not TMT Part A (rho = −0.31, $p < .207$), Digit Symbol (rho = −0.31, $p < .212$), delayed recall (rho = −0.09, $p < .735$), consistent long-term retrieval (rho −0.16, $p < .518$), or the Controlled Oral Word Association Test (rho = −0.41, $p < .095$). There was no relationship between baseline D scale scores and changes in depressive symptoms (rho = −0.04, $p < .859$). These findings are consistent with increased depression during IFN-α treatment that could not account for most cognitive symptoms. Pretreatment affective symptoms did not appear to be a risk factor for new depression.

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K. RAYLS, S. STIEFEL, & B. WILLIAMS. Myotonic Dystrophy: An Atypical Case Report.

Myotonic dystrophy (MD) is a genetic disorder characterized by a base triplet repeat on chromosome 19. The disorder is one involving many systems and predominantly effects muscle tone and utility. The variability of symptom presentation, motorically and cognitively, is vast. Due to the extreme heterogeneity of the disorder and range of potential sequelae, group studies may fail to capture the remarkable variability and degree of deficits which are possible, as significant effects tend to wash out across patients. As a result, literature available to patients, parents, and professionals may fail to capture the essence and severity of symptoms of those patients experiencing remarkable difficulties. We present a case of a 13-year-old male with genetically proven (1,270 CTG repeats; >99 repeats positive for the disorder) congenital myotonic dystrophy. He presented to our outpatient clinic experiencing developmental failure at home and in school and had not previously been evaluated neuropsychologically. Neuropsychological profile was remarkable for mild global cognitive reductions with marked relative weaknesses with regard to visual-spatial, perceptual, and executive abilities. Notable anxiety and social deficits were also present. Results of SPECT were remarkable for decreased perfusion in the occipital lobes bilaterally. MRI results were within normal limits. This case highlights the unique variability and clinical manifestations possible in the disorder. Additionally, commentary is provided regarding the functional impairments typically faced by children whose verbal skills are relatively preserved as compared to nonverbal skills, as well as implications for the neuropsychological service provider.

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J. NEALE, R. JACOBS, A. KORNBERG, L. SHIELD, & V. ANDERSON. Acute Disseminated Encephalomyelitis: Outcomes Related to Treatment and Age at Diagnosis.

Acute disseminated encephalomyelitis (ADEM), is a recently identified autoimmune inflammatory disease of the CNS that most commonly affects children and young adults, often following a virus or vaccination. ADEM predominantly affects cerebral white matter, with continued debate regarding the nature and chronicity of this pathology. While it is similar in many aspects to multiple sclerosis, ADEM differs with respect to age at onset and clinical course. Anecdotal clinical evidence indicates that while physical recovery is often complete, residual neuropsychological and behavioral sequelae may result. This study aimed to investigate the impact of such a transient condition, focussing on information processing/attentional skills, and functional areas including educational ability and behavioral function. Participants included 19 children, who had suffered from ADEM in the past 6 years, and an age-matched healthy control group ($n = 24$). Results showed that children with ADEM exhibited poorer performances than controls on both speed of processing and attentional measures. Within the ADEM group, disease severity was associated with outcome. Further, children who had contracted ADEM prior to age 5 years were more vulnerable to severe speed of processing and attentional problems, and experienced poorer functional outcome as measured by educational achievement and behavioral measures.

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G. ESKES, J. KLAGES, D. BENEDICT, & L. REES. Characteristics of the Clock Drawing Test in Stroke.

The Clock Drawing Test (CDT) is considered a useful cognitive screening tool for early dementia and monitoring cognitive impairment over time. Less is known about the utility of the CDT in other populations with focal neurological damage. The purpose of the present study was to examine the utility of the test in stroke patients admitted for rehabilitation, in terms of sensitivity to lesion location, underlying cognitive mechanisms, and assessment/prediction of functional impairment and rehabilitation outcome. One hundred patients (mean age = 71.4) admitted to a stroke rehabilitation unit were administered a neuropsychological screening battery including the Cognistat, Figure Cancellation, the CDT (draw version), and the Geriatric Depression Scale. Total mean CDT score (Freedman et al., 1994) differed significantly between patients with right and left hemisphere stroke (10.61 *vs.* 8.26, respectively). Stepwise linear regression was used to study the association of stroke and demographic variables, cognitive measures, and depression with the CDT score and revealed that only 3 subtests of the Cognistat (Comprehension, Construction, and Orientation) contributed significantly to the prediction of the CDT total score, accounting for 43% of the total variance ($p < .001$). The total CDT score was also included as a significant predictor of rehabilitation outcome at discharge, as defined by functional independence (Barthels Index, self-medication success) and resource need (length of stay and discharge destination). The Clock Drawing Test appears to be sensitive to lesion location, reflects a number of cognitive abilities, and may be a useful measure in the assessment of stroke patients for rehabilitation planning.

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J.E. MORGAN & E. CACCAPPOLO VAN VLIET. Amnestic Syndrome in a Large Callosal Glioma.

Neuropsychological impairment in brain tumors is variable and related to their size, location, and type. Some grow extremely large before any symptoms; cognitive symptoms may not appear for some time, if ever (i.e., "silent tumor"). When brain tumors manifest cognitively, they may cause generalized decline, related to increased intracranial pressure, or with discrete localized features. In the latter, direct/indirect effects of the tumor encroach on specific regions associated with distinct cognitive functions (e.g., angular gyrus/Gerstmann's Syndrome). We present J.B., a 54-year-old male who experienced difficulty concentrating and remembering. Neuroimaging revealed "... a very large, multi-lobulated mass in the corpus callosum, extending into the cingulate gyrus, occluding the posterior third ventricle and displacing bilateral inferior fornices." Results of comprehensive neuropsychological assessment were extraordinary: despite his enormous space-occupying mass, J.B. demonstrated preserved intellectual (FSIQ = 109), attention (intact digit span, PASAT), language (intact naming, fluency), and executive abilities (6 categories/15 perseverations on WCST, intact Stroop). Memory functions revealed a striking amnestic syndrome with scores at the 2nd and 1st percentiles, respectively, on delayed recall WMS–R LM/VR subtests. Similarly, impaired performance characterized his Hopkins with 13/36 words learned over 3 trials but 0/12 at delay. The bilateral nature of sensory loss on finger agnosia/graphesthesia failed to suggest disconnection features. These results are surprisingly circumscribed, given the tumor size, but speak to the specific nature of functions subserved by the diencephalon. Though cases have been reported of amnesias associated with callosal tumors, this is the first case report with comprehensive neuropsychological data attesting to remarkable preservation of other functions. MRI and test performances illustrate the unusual nature of these findings.

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A. LEMIEUX, F. CHARBEL, J. O'NEILL, B. BUICAN, & E. MARTIN. Neuropsychological Functioning Pre- and Post-Cerebral Bypass Grafting: A Preliminary Study.
Current methodology and theoretical modeling associated with cerebral artery bypass grafting (CeABG) are considerably more sophisticated than those employed in older extracranial-intracranial bypass procedures. CeABG is a procedure to normalize blood flow in patients with cerebrovascular occlusions, TIAs, or history of strokes. In this ongoing study of post-surgical outcomes, we report preliminary data on 10 patients (7 males, 3 females) who received neuropsychological testing pre- and post-cerebral CeABG. These surgical techniques were assisted by computer models of cerebral vascular function developed by the UIC division of Vascular Neurosurgery. Patients had a mean age of 46.2 and all were medically stable at follow-up testing. Patients were evaluated at baseline and 4–6 month follow-up on 6 cognitive domains: attention, memory, verbal fluency, visual perceptual, psychomotor functioning, and executive functioning. We defined "improvement" within each cognitive domain as a positive change of 1 + *SD* from baseline. By these criteria, 80% of patients showed an improvement in at least 1 cognitive domain, and 65% showed improvement on 2 or more cognitive domains. None of the patients demonstrated a decline in cognitive functioning. Observed improvement was most commonly observed on measures of attention/concentration, verbal fluency, and psychomotor functioning. Results suggest that improvement in clinical status might be characterized as an increase in cognitive efficiency and mental speed. These preliminary data indicate that NP performance may be a sensitive indicator of clinical improvement following CeABG.
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J. EVANS, J. WELCH, S. BAJPAI, & C. CALLEY. Cognitive Status in Hemodialysis as a Function of Fluid Compliance With Treatment.
Previous work has suggested that dialysis improves cognitive functioning in hemodialysis patients. Other researchers have suggested that improvement in cognitive performance is due to improvements in anemia among these patients. Improvements in cognitive performance may lead to better levels of self-care and compliance with treatment. The present study examined cognitive functioning in patients receiving hemodialysis in order to determine the effects of cognitive performance on fluid compliance. One hundred and forty seven patients were assessed with a brief screening instrument, the Cognistat, to determine their current level of functioning while being dialyzed. Fluid noncompliance was operationalized as interdialytic weight gain above 1 kg/day. Rates of impairment on the Cognistat subscales ranged from 24% (judgment) to 54% (memory) in this sample. Roughly 68% of the sample was noncompliant during the course of treatment. Results found no differences in mean levels of cognitive performance as a function of noncompliance and only modest relationships (r = .14) of measures of anemia to certain aspects of cognitive performance. In order for the hemodialysis patient to benefit from self-care education, the patient must be able to understand, remember, reason, and use cognitive processes to modify behavior. These results suggest that more in-depth assessment of cognitive performance may be needed. In addition, this assessment may need to be conducted on a day when treatment is not received.
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H. BAWDEN, P. ACOTT, J. CARTER, D. LIRENMAN, W. MacDONALD, M. McALLISTER, M.C. McDONNELL, S. SHEA, & J. CROCKER. Neuropsychological Functioning of Children with End-Stage Renal Disease.
The number of children receiving treatment for end-stage renal disease (ESRD) has increased over the past 15 years. Due to lack of organ donors and loss of grafts, many children remain on dialysis for lengthy periods of time. Earlier studies found that children with ESRD were at risk for developmental delay and neurological problems. Neuropsychological deficits also have been reported, although there is little information on the abilities of school-aged children with ESRD, especially in cohorts who have benefitted from recent improvements in medical management. The study was carried out at 2 tertiary-care pediatric hospitals. We compared the neuropsychological abilities of children with ESRD and sibling controls. Differences in age were controlled by using age standardized scores. Neuropsychological assessments were carried out by technicians who were unaware of the participants' medical status. Summary variables were used in the analyses in order to limit the number of comparisons. There were no group differences in WISC–III, VIQ, PIQ, or FSIQ, or on measures of academic achievement in language arts or mathematics. The groups were comparable in their performance on measures of visual memory, and on most of the tests of verbal memory, although children with ESRD had lower scores on a measure of immediate verbal memory, and on measures of fine motor coordination and ability to copy geometric designs, than their siblings. There were no differences on teacher or maternal ratings of behavior. Most of the neuropsychological abilities of children with ESRD were in the low average range indicating that their neuropsychological outcome is more favorable than earlier reports indicated.
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Poster Session 5/12:00–2:30 p.m.

MULTIPLE SCLEROSIS

C. CIANCIULLI, L. KRUPP, A. BELMAN, T. PRESTON, C. CHRISTODOULOU, T. MORGAN, M. MILAZZO, P. MATTIS, K. BLITZ, B. WILSON, & G. NOVAK. Neuropsychological Functioning of Adolescents with MS: Preliminary Findings.
Multiple sclerosis in adults has been shown to be frequently associated with cognitive decline, however, there is a paucity of information regarding the implications of early-onset of MS on cognitive development. MS in adolescence raises unique issues because the disorder occurs within the context of a developing CNS, specifically during myelination cycles of different regions of the brain. Perturbations in myelinogenic process during critical periods of development may affect cognitive development. We report preliminary findings on 10 adolescents with a clinically definite diagnosis of MS. Age range: 13–17. Average age at onset of symptoms: 13. Female:male ratio is 8:2. Four participants are African American and the rest are Caucasian. The participants received a comprehensive neuropsychological battery. Test scores that were 1.5 *SD* or below normative means were considered within the impaired range. General cognitive functioning in this group was intact, but specific areas of cognitive deficit were identified in language (40%), academic (60%), attentional (70%), visuomotor (20%), and memory functions (30%). These preliminary findings indicate that cognitive impairment is present in early-onset of MS and is heterogeneous in nature as in adult patients. Interestingly, outcome measures such as the Wisconsin Card Sorting Test and the Paced Auditory Serial Addition Task, which are often impaired in adult MS samples, were within normal limits in our sample of MS adolescents. Further studies are needed to characterize cognitive domains affected by early-onset of MS. Longitudinal studies will be useful to understand the interplay between the course of MS and cognitive development over time.
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D. POLEN & P. ARNETT. Motor Output Difficulties Contribute to Speeded Cognitive Task Performance in Multiple Sclerosis.
Individuals with multiple sclerosis (MS) consistently show cognitive difficulties on speeded neuropsychological tests. Additionally, many MS patients have slowed speech and/or motor writing deficits. Because speeded neuropsychological tests require rapid oral motor or motor writing responses, motor output difficulties could contribute to MS patients' perfor-

mance on these tasks. The current study was designed to evaluate this hypothesis. We administered a series of neuropsychological tests to 52 clinically definite MS patients. Cognitive tests were grouped into 2 categories: (1) Those requiring a speeded oral motor response (COWAT, Symbol Digit, Visual Elevator subtest from the Test of Everyday Attention, & PASAT), and (2) those requiring a speeded written motor response (2 Digit Cancellation Tasks). Measurement of oral motor speed and motor writing speed with minimal cognitive demands was made using a test involving a modification of Symbol Digit requiring the oral repetition of numbers in boxes (Symbol Digit Oral Motor Test—SDOMT) and the Symbol Copy test from the WAIS–III, respectively. After controlling for age, education, overall intellectual functioning, and EDSS score, regression analyses indicated that the SDOMT and the Symbol Copy test contributed significant (p's $< .05$ to .001) unique variance to performance on speeded oral motor cognitive tests (range of r^2 change values = .10 to .27) and speeded motor writing cognitive tests (range of r^2 change values = .18 to .20), respectively. Our results suggest that MS patients' motor output difficulties significantly influence their performance on cognitively demanding speeded neuropsychological tests. Thus, reports of MS patients' speeded cognitive deficits may be inflated by uncontrolled motor output difficulties.

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J. J. RANDOLPH, P.A. ARNETT, & P. FRESKE. Meta-Attention in MS: Relationship with Tested Cognitive Functioning, Psychopathology, and Cognitive Fatigue.

Though some metacognitive domains such as metamemory have generated a great deal of research interest, other areas have received sparse empirical attention, particularly in neurological populations. Meta-attention, or self-reported attentional ability, has not previously been examined in multiple sclerosis (MS) patients, despite the fact that patients often report attentional and processing speed difficulties during neuropsychological evaluations. The present study examined whether meta-attention was associated with anxiety, depression, cognitive fatigue, and neuropsychological tests of attention in MS. Thirty-nine *definite* MS patients were administered measures of attention/concentration (Symbol Digit Modalities, Letter-Number Sequencing, Visual Elevator, PASAT), anxiety (SCL–90 Anxiety scale), depression (CMDI–Mood and Evaluative scales), cognitive fatigue (FIS–Cognitive Fatigue scale), and meta-attention (abbreviated version of Brown ADD scale) as part of a larger study. Correlational results indicated that meta-attention was significantly associated with cognitive fatigue and anxiety but with no neuropsychological measures of attention/concentration. Further, a stepwise multiple regression analysis revealed that cognitive fatigue was the only significant predictor of meta-attention after accounting for demographic variables and physical disability, accounting for 66% of meta-attention variance. Thus, MS patients' perceptions of their everyday attention do not appear to be related to their actual performance on objective attentional tasks, but are significantly related to the levels of cognitive fatigue and anxiety they report. In particular, patients' cognitive fatigue could make them feel like they are performing much worse than they actually are objectively, a finding that has relevance for clinicians and MS researchers alike.

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R. AUPPERLE, W. BEATTY, F. SHELTON, & S. GONTKOVSKY. Three Screening Batteries to Detect Cognitive Impairment in Multiple Sclerosis.

Cognitive impairment affects 40 to 65% of patients with multiple sclerosis (MS). Affected individuals cannot be identified by disease type, duration, severity of physical disability, or MMSE scores. In this ongoing study, we are directly comparing the sensitivity for detecting impairment of 3 brief cognitive batteries: NPSBMS (Rao et al., 1991), SEFCI (Beatty et al., 1995), and the RBANS (Randolph, 1998), using a within-subjects design. On individual tests (indexes) scores below the 5th percentile are considered impaired. There are 4 measures per battery. Of 30 patients tested to date, the number showing impairment on 1 or more tests was: NPSBMS = 22, SEFCI = 23, RBANS = 11. The number showing impairment on 2 or more tests was: NPSBMS = 11, SEFCI = 15, RBANS = 5. Average administration times in minutes were: NPSBMS = 32.4, SEFCI = 23.4, RBANS = 24.0. The Cortical-Subcortical Deviation Score, a measure derived by comparing the Attention and Visuospatial-Construction Indexes to the Language and Delayed Memory Indexes of the RBANS accurately classifies the majority of dementia patients with Alzheimer's, Huntington's, Parkinson's, or subcortical vascular disease. MS produces a subcortical pattern of dementia, but only 47% of all patients were classified as "subcortical" by the Deviation Score. Considering only patients who scored below 27 on the MMSE (lower limit of normal), the percent subcortical was 67. These preliminary findings suggest that both the NPSBMS and the SEFCI will be more sensitive for detecting cognitive impairment in MS than the RBANS. The SEFCI, however, can be administered more quickly than the NPSBMS.

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J. BRUCE & P. ARNETT. Meta-Memory in Nondepressed, Mildly Depressed, and Moderately Depressed MS Patients.

Memory difficulties and depression are among the most prevalent symptoms reported by patients with multiple sclerosis (MS). Memory difficulties are estimated to hinder 40–60% of these patients; likewise, approximately 50% of patients report problems with subclinical or clinical depression. Nonetheless, relatively little is known about how depression may be related to complaints of memory disturbances in this population. In the present investigation, moderately ($n = 25$), mildly ($n = 21$), and nondepressed ($n = 27$) definite MS patients' ratings of their memory were compared to their performance on composite measures of verbal memory and capacity, demanding attention/concentration. Results supported a mixed model that integrates the constructs of depressive realism with Beck's theory of depression. Consistent with the depressive realism literature, nondepressed MS patients significantly overestimated their abilities compared with their performance on the memory ($p < .01$) and attention/concentration ($p < .05$) indices. Moreover, moderately depressed patients neither under nor over estimated what might be deemed their true ability. Coinciding with this latter finding, moderately depressed patients' self-reports of memory were significantly correlated with their performance on the attention/concentration index ($r = .44$, $p < .05$). In contrast to the findings that lend support to depressive realism, mildly depressed patients reported their memory to be significantly worse than their performance on the composite memory and attention/concentration indices (both, p's $<$ .01). These data support Beck's notion that depressed patients are characterized by a negative cognitive schema. Theoretical implications for the treatment of depression and memory problems among patients with MS are discussed.

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M. BRADSHAW, P. MASSMAN, N. COOKE, M. HISCOCK, & S. APPEL. Cluster Analysis Identifies Neuropsychological Subgroups in ALS.

The historical view that amyotrophic lateral sclerosis (ALS) does not affect the mind has been overturned by evidence from studies employing neuropsychological testing and neuroimaging. Research indicates that a significant number of ALS patients incur cognitive sequela, particularly diminished frontal lobe functioning. While executive dysfunction has been a common finding, the results of past research have been inconsistent regarding the prevalence and degree of impairment, as well as ALS's impact on other cognitive domains, such as memory. This study sought to further delineate the affects of ALS on cognition by examining the neuropsychological performance of a large sample of ALS patients ($n = 248$) and employed cluster analysis to identify possible subgroups within the sample. Forty percent of the sample was classified as cognitively impaired

utilizing a cutoff of performance on 2 or more of 8 key variables being at or below the fifth percentile. Cluster analysis yielded a stable, meaningful 4-group solution. One high functioning cluster showed no evidence of cognitive decline, while a second cluster evidenced global decline. A third cluster demonstrated a mild decline in memory skills. The fourth had incurred a moderate decline in executive functions. Greater cognitive impairment was associated with a lower premorbid level of cognitive functioning, greater and more rapid progression of motor impairment, and higher rates of depression. These results indicate that neuropsychological performance of ALS patients is highly variable and that reliance on group data may obfuscate subgroups, and thereby misrepresent the cognitive sequela of ALS.

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S. NOLAN, M. NORMAN, C. COTTER, & J. COREY-BLOOM. Tower of California Performance in a Multiple Sclerosis Population.

Previous studies of individuals with multiple sclerosis (MS) have demonstrated executive functioning deficits in planning, conceptual reasoning, and problem-solving on a tower construction task. This current study assessed performances of MS subjects and normal controls (NC) on a new task, the Tower of California (Delis-Kaplan Executive Functions Scale). This manually administered task uses the same principles and rules as the Tower of Hanoi, requiring strategic problem-solving to construct designs in the fewest number of moves possible, but has more complex designs. The performances of age-and-education-matched Poser-defined MS subjects ($n = 38$) were compared to normal controls (NC: $n = 19$). MS and NC subjects did not differ significantly in the total number of attempted designs, number of correctly completed designs, total number of moves, or errors. Follow-up analyses analyzed the number of moves per trial and number of errors per trial. Again, no significant differences were found between MS and NC subjects. The lack of significant differences on this measure may reflect ceiling effects by both groups or possibly a lack of overall impairment in the MS group. Further analyses of lesion location, lesion burden, and type of MS may provide discriminative utility on planning and problem-solving strategies.

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P. FRESKE, P. ARNETT, & J. RANDOLPH. Comorbidity of Depression and Anxiety in Multiple Sclerosis.

The high comorbidity of depression and anxiety is well-established. Clark and Watson's (1991) tripartite model is widely accepted as the best model for explaining this comorbidity in the general population (Nathan & Langenbucher, 1999). In this model, generalized distress is shared by depression and anxiety, with somatic complaints being unique to anxiety. In the current study, we investigated the generalizability of the tripartite model to multiple sclerosis (MS) patients. Forty-nine clinically definite MS patients were administered the Symptom Checklist 90–Revised, and the Chicago Multiscale Depression Inventory (CMDI). For the SCL-90–R, the Positive Symptom Distress Index (PSDI) and the CMDI Evaluative subscale were used to measure generalized distress, the depression and anxiety subscales of the SCL-90–R used to measure depression and anxiety, respectively, and the SCL-90–R somatization subscale used to measure somatic complaints. Consistent with the tripartite model, depression and anxiety correlated at .70, $p < .001$. Using the SCL-90–R anxiety scale as the criterion variable, generalized distress accounted for 21% of the variance at the first step of a hierarchical regression ($p = .005$), and somatic complaints accounted for significant unique variance at the second step (r^2 change = .16, $p = .001$). Contrary to the tripartite model, hierarchical regression analysis revealed that depression accounted for an additional 16% unique variance in anxiety when entered in at the third step. Our results suggest that, in contrast to the general population, generalized distress cannot fully account for the comorbidity of depression and anxiety in MS.

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C. COTTER, M. NORMAN, S. NOLAN, & J. COREY-BLOOM. The Effect of Cognitive Fatigue on CVLT Performance in Multiple Sclerosis.

The impact of cognitive fatigue on neuropsychological performance has not been well characterized. Recent research suggests that persons with multiple sclerosis (MS) experience a greater amount of cognitive fatigue than normal controls (NC) following cognitive tasks. The current study compared pre-task California Verbal Learning Test–II (CVLT–II: Delis et al., 2000) performance to post-task California Verbal Learning Test (CVLT: Delis et al., 1987) performance. CLVT–II and CVLT indices of Trial 1–5 Total Words, Short Delay Free Recall (SDFR), Long Delay Free Recall (LDFR), Recognition Discriminability, and Learning Slope were compared between 23 Poser-defined MS and 17 age and education matched NC participants. Both groups' memory performances declined significantly from CVLT–II to CVLT on indices of Total Words, SDFR, and LDFR ($p < .001$), but not Learning Slope. Recognition Discriminability performance did not decline significantly for either group. The MS and NC groups' performances did not differ significantly from each other on any of the 5 CVLT–II and CVLT measures. Subjects were expected to demonstrate practice effects with better performance on the CVLT; however, both groups' performances declined to the same degree. These preliminary findings suggest that, although both groups demonstrated significantly worse recall ability following a cognitive task, their learning rate was unchanged. Moreover, these findings suggest that recall performance may be more impaired if memory measures are administered at the end of a cognitive battery.

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L. STROBER, P. ARNETT, D. POLEN, & J. BRUCE. Is Sleep Disturbance Reflective of Depression or Disease Symptomatology in MS?

Depressive symptoms are common in individuals suffering from multiple sclerosis (MS). Recently, a debate has emerged on whether or not some MS symptoms are confounded with neurovegetative symptoms of depression. For example, sleep disturbance is a neurovegetative symptom of depression that is also an MS symptom. The present study was designed to evaluate whether sleep disturbance indicated on the Beck Depression Inventory (BDI) reflects depression or disease symptomatology in 43 definite MS patients. We modified the BDI by including a series of follow-up questions to the sleep item that asked patients to rate which of a list of factors most contributed to their sleep difficulties. Sixty-two percent of the patients complained of some sleep disturbance. Fifty percent of this subset of patients attributed their sleep complaints primarily to physical symptoms of MS, such as bladder incontinence, muscle stiffness, or leg spasms. In contrast, only 19% attributed their sleep difficulties primarily to psychological factors, such as worry. Furthermore, for the "physical factors" group, there was no correlation between their sleep disturbance and depression as measured by a summary index comprised of the Mood and Evaluative subscales of the Chicago Multiscale Depression Inventory (CMDI). In contrast, there was a significant correlation between sleep disturbance and the CMDI index in the "psychological factors" group ($p = .002$). Our data suggest that reports of sleep problems on depression inventories *can* reflect depression in MS, but only in patients who also indicate that psychological factors are the primary cause of their sleep problems.

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K. FUCHS, J. REILLY, & C. MANNING. Cognitive Performance by Disease Course in Individuals with Multiple Sclerosis.

Variability in cognitive performance across individuals with multiple sclerosis (MS) has been observed even when variables such as age, education, and disease duration were taken into account. This may be due to the inclusion of groups with a different disease course within a single sample rather than examining the groups separately. This study investigated differences in cognitive performance between individuals with a relapsing-remitting course (RR, $N = 19$) and those with secondary progression (SP, $N = 14$). *Results:* There was a significant difference between the groups

on Trails A & B with the SP group demonstrating worse performance. Further investigation into measures of attention and speed of processing indicated roughly equivalent performance across groups on measures without a manual motor component (Verbal Fluency, Letter-Number Sequencing, Digit Span). Performance on measures with a demand for visuomotor integration and speed (Trails A, Trails B, Coding) was significantly worse in the SP group. This is consistent with that group's relatively greater physical disability as assessed by the EDSS (RR = 2.6, SP = 4.6). The 2 groups did not differ in age, education, level of depression, or level of performance across the specific domain indices of the Repeatable Battery for the Assessment of Neuropsychological Status. Mean performance within each domain was in the average to low average range compared to test norms. *Conclusion:* Individuals with SP MS had more motor speed deficits than those with a RR course. Differences across other cognitive domains were not observed. The impact of this finding on disability warrants further exploration.

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B.C. McDONALD, H.A. WISHART, R.M. ROTH, L.A. FLASHMAN, L.H. KASPER, K.A. RYAN, C.E. FADUL, & A. J. SAYKIN. Relation of Fatigue, Mood, and Perceived Memory Impairment to Cognition in MS.

The purpose of this study was to investigate the relationship of mood, fatigue, and perceived memory impairment with cognition in multiple sclerosis (MS). Previous research has found that mood disturbance contributes to, but cannot fully account for, cognitive impairment in MS. However, the contribution of fatigue to disturbance in mood and cognition in these patients is unclear. Participants in this study included 32 MS patients and 20 age- and education-matched controls, who completed the CVLT, Trail Making Tests (TMT), Profile of Mood States (POMS), Fatigue Severity Scale (FSS), and Squire Memory Self-Rating Scale (SRS). We hypothesized that MS patients would report higher levels of perceived memory impairment and fatigue than controls, and that these factors would correlate with objective cognitive impairment and mood disturbance. As predicted, significant differences were seen between groups on CVLT, TMT, SRS, and FSS, with the MS group evidencing impairment relative to controls ($p < .05$). Contrary to our expectations, FSS correlated significantly with SRS only in controls, and performance on cognitive tasks was unrelated to either FSS or SRS score. In summary, while MS patients demonstrated significantly poorer performance on some measures of cognitive functioning relative to controls, this did not relate to patients' perception of cognitive impairment, mood state, or level of fatigue. In future research, development of measures specifically targeting cognitive as opposed to physical fatigue will be useful in clarifying the relationship between subjective and objective cognitive impairment in MS.

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H.A. WISHART, R.M. ROTH, L.A. FLASHMAN, B.C. McDONALD, L.H. KASPER, K.A. RYAN, C.E. FADUL, & A. J. SAYKIN. Executive Dysfunction Contributes to Verbal Learning Deficits in Multiple Sclerosis.

Learning and memory are often impaired in multiple sclerosis (MS). Various studies suggest the deficits are at least partly secondary to impairment of executive functions such as conceptual reasoning, processing speed, and/or working memory. In the present study, mediation modeling was used to further examine the extent to which executive dysfunction contributes to verbal learning deficits in MS. Participants were 31 patients with mild to moderate relapsing remitting MS and 33 healthy matched controls. Measures were CVLT Total Learning (CVLTTOT), Trail Making Test B (TMTB), and Digit Span Backward (DB). Evaluation of a direct model revealed a significant relation between MS and poorer verbal learning ($p < .01$). Mediated modeling could not be examined for DB, which showed no group difference. However, when TMTB was included in the model as mediator, results indicated a significant Group-TMTB-CVLTTOT path ($z = 2.82$, $p < .005$), and the direct relation between group and learning declined to a nonsignificant level. In other words, the relation between group membership and CVLT total learning was partially mediated by processing speed and mental flexibility as measured with TMTB. The results support a model in which the verbal learning impairment in MS is partly attributable to deficits in executive ability. Replication in a larger sample, together with evaluation of models involving other potential mediators (such as working memory and strategy use) will help elucidate the underlying cognitive deficits contributing to memory impairment in MS, and may help guide rehabilitative efforts.

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J.A. BOBHOLZ, S. DURGERIAN, J. ZAFEROS, D. MILLER, J. RAO, C. ELSINGER, E. MAAS, L. LOBECK, & S.M. RAO. Neural Activation Patterns Associated With Recognition Memory Performance in Multiple Sclerosis: An fMRI Study.

Approximately 45–60% of MS patients experience cognitive decline during their lifetime. The severity of cognitive deficits is correlated with the extent of cerebral white matter lesions identified on structural MR scans. Studies have consistently shown that memory functions, particularly new learning skills, are compromised in MS; however, there has been some debate regarding the specific stage of memory that is affected (encoding *vs.* retrieval). In this event-related fMRI investigation, we imaged MS patients ($n = 15$) and demographically-matched control subjects ($n = 8$) during encoding and recognition of visually presented words. During the encoding phase, subjects were asked to make a semantic decision (abstract *vs.* concrete) regarding 60 nouns, presented every 4.5 seconds. Thirty minutes later, subjects underwent recognition testing involving 60 targets and 60 foils. MS subjects also underwent FLAIR MR imaging to measure extent of T2-weighted cerebral white matter lesions. No significant group differences were observed in recognition accuracy. Using a regression model, the relationship between lesion load and extent of neural activation was examined within the MS sample. During encoding, a positive relationship between lesion load and activation was seen in bilateral dorsolateral prefrontal cortex and lateral cerebellum, areas commonly activated by working memory tasks. In contrast, lower lesion load was associated with increased activation in the left hippocampal gyrus, commonly associated with long-term memory consolidation. These data suggest that, even when recognition memory is normal, MS-related white matter lesions alter the neural systems involved in encoding, resulting in a shift from long-term to working memory strategies.

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M.P. SANTA MARIA, R.H.B. BENEDICT, M.L. COAD, R. BURKARD, R. BAKSHI, B. WEINSTOCH-GUTTMAN, & A.H. LOCKWOOD. Regional Cerebral Blood Flow (rCBF) During Auditory Attention Suggests Plasticity in Psychometrically-Normal Patients With Early Multiple Sclerosis.

Recent functional neuroimaging research in multiple sclerosis (MS) suggests recruitment of homologous contralateral cortex and alteration of activity within primary sensorimotor cortex during finger movements. The extent of such plastic change in cortical activation was associated with total lesion volume on magnetic resonance imaging (MRI). We employed a combined ^{15}O H_2O positron emission tomography (PET) and event-related potentials (ERP) paradigm to study auditory attention in MS patients without requiring motoric responding. Our objective was to determine whether there are abnormalities in rCBF in MS during auditory attention, and if plasticity in attentional networks could be demonstrated in mildly affected patients. Comparisons between MS ($n = 16$) and normal controls ($n = 12$) revealed diminution of rCBF in anterior cingulate cortex (ACC). Our data also revealed differential patterns of activity within the MS group with reduced, and less lateralized temporal lobe activity. These

changes were apparent in patients with early MS who performed well within the normal range on neuropsychological tests. We conclude that rCBF in MS patients during auditory attention is reduced, and that plasticity within attentional networks occurs early in the disease process.
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P. ANDERSON & B. BANWELL. Neuropsychological Functioning in Pediatric Multiple Sclerosis: Preliminary Findings of a Prospective Investigation.
Multiple sclerosis (MS) is a relatively rare demyelinating disease, with approximately 3.5–7.5/100,000 persons newly diagnosed with MS each year. Pediatric MS is much rarer, as only 3–5% of total diagnoses are made at 16 years of age or younger. Adult onset MS has been well-studied and significant neuropsychological deficits have been documented (e.g., Rao, Leo, Bernardin & Unverzagt, 1991), while the available literature on pediatric MS consists of case reports and retrospective case series. In our prospective investigation, children and adolescents ($n = 10$; 9–17 years of age) with clinically definite MS (time since diagnosis ranging from 2 months to 4 years, 9 months) completed a comprehensive neuropsychological battery. Relative to normative samples, the MS group performed significantly poorer on some indices from a measure of psychometric intelligence (FSIQ, VIQ, PIQ, VCI), visual motor integration, visual learning and memory, story recall, and spelling. Though these findings are more widespread than those typically reported in the adult literature, the weaknesses noted are consistent with adult findings. The influence of time since diagnosis was also explored (< 2 years, $n = 6$; > 2 years, $n = 4$). Participants with a longer time since diagnosis performed significantly worse on some indices from a measure of psychometric intelligence (FSIQ, PIQ, POI), visual perception/construction, reading comprehension, and applied mathematical knowledge. These findings are more consistent with those reported in the adult literature, with a clear deficit in visual-spatial processing in the face of relatively preserved verbal functioning found for those participants with a longer time since diagnosis.
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Poster Session 5/12:00–2:30 p.m.

CROSS CULTURAL

R. CHAN, I. ROBERTSON, & T. MANLY. Cross-Cultural Validation of the Test of Everyday Test of Attention With Confirmatory Factor Analysis.
The Test of Everyday Attention (TEA) was developed in improve upon existing methods of assessing attentional problems in clinical practice. It consists of 8 subtests measuring sustained, selective, and divided attention. Its construction was also designed to mimic everyday activities. However, the construct validity of the TEA has not been fully studied with a more stringent methodology. This study aimed to examine the construct validity and its stability across cultures with confirmatory factor analysis (CFA). A sample of 148 healthy UK and 133 Hong Kong Chinese participants were recruited. They were well-matched with gender proportion and educational level. Three models were tested in the present study: (1) the one from the original proposed underlying attentional contructs (Visual Selection, Sustained Attention, and Switching) (Robertson et al., 1996); (2) the discovered 4-factor structure by exploratory factor analysis (Robertson et al., 1996); and (3) the discovered 4-factor structure by exploratory factor analysis (Chan et al., 1999). The CFA solutions suggested that the 3-factor model provided the best fit for both samples (AGFI = 0.83, GFI = 0.91, CFI = 0.91 for UK sample; AGFI = 0.85, GFI = 0.93, and CFI = 0.90 for HK sample). A direct comparison of chi-squares further indicate significant differences among the 3-factor models and the alternative models ($\chi^2 = 6.54$, $p = 0.075$ for UK sample, and $\chi^2 = 25.3$, $p = 0.001$ for HK sample). Therefore, the 3-factor model provides the best fit of attentional components embedded in the TEA and it is consistent and stable across cultures.
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R. CHAN, M. WONG, E. CHEN, R. CHEN, A. WONG, L. LAM, & D. NGUYEN. Verbal Fluency Norms in a Community Population in Hong Kong.
Category fluency tests are important cognitive and clinical neuropsychological assessments, particularly for patients with frontotemporal impairments like in schizophrenia and dementia. The lack of local Hong Kong Chinese norms together with the growth in the number of Hong Kong immigrants to North America, Canada, and Australia, have increased the need for well-validated normative data for Hong Kong Chinese. This study aimed to provide normative data for healthy Cantonese-speaking Hong Kong Chinese, ranging in age from 16 to 65, on 4 commonly used measures of category fluency—"animal," "means of transport," "food," and "furniture." A total number of 100 healthy subjects (42 male and 58 females) were recruited in the community. The mean age and educational level of the sample was 32 ($SD = 11.76$) and 11.31 years ($SD = 3.64$), respectively. The findings indicate that the category "food" and "animal" had the highest mean number of citations (mean = 21.52, $SD = 7.14$ for food; mean = 20.07, $SD = 5.84$ for animal), whereas the category "furniture" and "means of transport" had the lowest mean score (mean = 14.24, $SD = 4.79$ for furniture; mean = 15, $SD = 3.86$ for means of transport). Rankings of frequently cited individual items within each category were also presented. The implication of applying this western driven measure in Hong Kong Chinese and psychiatry research is discussed.
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L. WALKER, A. SMITH, S. KINNEY, & J. TIBBS. Neuropsychological Norms for African-Americans.
Neuropsychological tests are commonly used to evaluate deficits associated with traumatic brain injury (TBI). TBI produces a variety of cognitive and behavioral deficits that can be identified through neuropsychological tests, which can assist in the development of specific rehabilitative strategies that may facilitate the patient's ability to function better both occupationally and socially. Studies have shown that individuals of lower socioeconomic status (SES) have a greater likelihood of sustaining a TBI. Further, African-Americans tend to be over-represented at the lower end of the SES. One long-standing issue with standardized testing has been the lack of adequate normative test data for non-European-Americans. Cross-cultural and psychometric psychologists suggest that one method for providing adequate clinical evaluation is to develop separate normative data for different racial groups as is often done with other demographic factors (i.e., age, gender, etc.). In the current preliminary study, 20 African-American, orthopedic patients were recruited from an acute care orthopedic hospital unit. Patients with a history of drug/alcohol abuse, psychiatric disturbance, or neurological illness were not included in the study. Cognitive measures were administered 2 to 5 days post-injury involving orientation, attention, concentration, speech and language, perceptual processes, memory, new learning, and executive functions. Preliminary results indicate that African-American participants performed below normative means on some subtests of the Wechsler's Adult Intelligence Scale–Third Edition (WAIS–III) and at the normative mean on other WAIS–III subtests. A similar pattern was observed on neuropsychological measures.
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E. GÓMEZ, F. OSTROSKY-SOLIS, A. ARDILA, & M. ROSELLI. Neuropsychological Batteries for the Assessment of Spanish-Speaking Subjects.
The purpose of this research was to develop, standardize, and test the reliability of 2 neuropsychological test batteries in Spanish. Both tests

have standardized procedures for administration and scoring and include items that are culturally sensitive and relevant for the Spanish speaking community. (1) NEUROPSI is a screening instrument developed to assess a wide spectrum of cognitive functions including: orientation, attention, memory, language, visuo-perceptual abilities, and executive functions. Normative data in a 800 monolingual, Spanish-speaking sample from 16 to 85 years of age is presented. Four age groups were used (16–30, 31–50, 51–65, and 66–85 years). In each age range, 4 different educational levels were taken (zero, 1–4, 5–9, and 10–24 years of formal education). Sensitivity and specificity data for the detection of mild cognitive impairment and dementia are presented. (2) NEUROPSI Attention and Memory was designed to evaluate in detail attention and memory processes and includes: orientation (time, space, and person), attention and concentration, frontal functions, and verbal and visual memory during encoding and retrieval of information. Normative data in a 800 monolingual, Spanish-speaking subject sample from 6 to 85 years of age, divided according to 14 age groups, is presented. The effects of age and education as well as factor structure, common and specific subtest content, inter-rater and test-retest reliability are analyzed.

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T. GOLLAN, R. MONTOYA, & G. WERNER. Semantic and Verbal Fluency in Spanish-English Bilinguals.

The verbal fluency task is frequently used to diagnose cognitive disorders, and though bilingualism is also common, little is known about how it affects this task. In previous research, bilinguals were more likely to have word-finding difficulty relative to monolinguals. Thus, we predicted that bilinguals would score lower than monolinguals on this task. We compared college-aged bilinguals to monolinguals on word production in 12 semantic and 10 letter categories (including oft-used Animals, Fruits, Vegetables, Clothing, F, A, and S). Monolinguals produced words in English only whereas bilinguals used English on half the trials and either language on the other half. With 2 languages the number of exemplars in letter categories virtually doubles, thus we also predicted that bilinguals might perform better than monolinguals on mixed-language trials. As predicted, in English-only trials bilinguals produced fewer exemplars than monolinguals on semantic categories. There was also a significant but less consistent difference for letters. The bilinguals' relatively improved performance on letter categories may indicate that bilingualism reduces the number of words retrieved automatically, but also enhances the ability to switch from 1 phonological subcategory to another and/or to carry out effortful search using phonological cues. Surprisingly, and consistent with recent literature showing that language switching is very difficult, bilinguals could *not* produce more words when they used both languages (on either semantic or letter categories). Overall, our results suggest that lower performance (-1 *SD*) on verbal fluency (especially semantic) may be normal for fluent bilinguals and should be considered in diagnosis of cognitive impairments.

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M. ARELLANO, M. PÉREZ, & F. OSTROSKY-SOLIS. Electrophysiological Index of Functional Organization of the Illiterate Brain.

Several studies have reported that functional brain organization is different between illiterate and literate subjects. A probe evoked potentials (EPs) procedure (Papanicolau et al. 1987) was used to assess the relative engagement of both cerebral hemispheres during verbal and nonverbal tasks in a group of 10 illiterate and 10 literate subjects. The paradigms used involve recording of EPs to a probe stimulus (click) during a control condition in which the subjects attend to this stimulus, and during 3 different conditions (words, faces, and music) where the subjects ignore the probe and are engaged in other concurrent stimuli. The amplitude of the EPs recorded from surface electrodes over both hemispheres is maximal and equal bilaterally during the cognitive tasks. Significant differences were found between illiterates and literates during the processing of words, although both showed greater activation of left areas, activation was more spread in illiterates. During the processing of music, illiterates activated right frontal areas, whereas literates activated left frontal areas. No significant differences were found during the processing of faces, where both groups showed activation of right fronto-central areas. These findings suggest that learning to read and write influences the functional organization of the adult brain.

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A. LOZANO, H. PICASSO, M. RAMÍREZ, & F. OSTROSKY. COGNIALFA: Cognitive Profile and Neuropsychological Rehabilitation of Adult Illiteracy.

Several studies have pointed out that illiterates show lower scores than literates in some neuropsychological tests, such as visuo-constructive abilities, similarities, verbal memory, and phonemic verbal fluency. Based on these findings, a learning-to-read program was developed. This program, named COGNIALFA, gives practice in the abilities mentioned above and it also includes neuropsychological tasks for improving attention, memory, language, and executive functions. The program lasts 4 months. Two groups were assessed before and after completing the learning-to-read training program using the NEUROPSI (Ostrosky, Ardila, & Rosselli, 1997; 1999) neuropsychological test battery and several tests that evaluate phonological awareness as well as reading and writing prerequisites. The COGNIALFA method was administered to the experimental group ($n = 15$), whereas a traditional procedure in learning to read and write was administered to the control group ($n = 15$). The experimental group showed higher improvement compared to the control group in Orientation in Time, Digits Backward, Visual Detection, Verbal Memory, Copy of a Semi-Complex Figure, Language Comprehension, Phonological Verbal Fluency, Similarities, Calculation Abilities, Sequences, and all of the recall subtests in the NEUROPSI. Performance on standard reading tests and phonological awareness tests was also significantly higher in the experimental group. Training and reinforcing those abilities in which illiterates show deficits result in a significant improvement in neuropsychological test scores and facilitate the learning-to-read process.

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J. GRIGSBY, K. KAYE, S. SHETTERLY, J. BAXTER, & R. HAMMAN. Hispanic Excess of Executive Cognitive Impairment Is Associated With Acculturation.

In the San Luis Valley Health and Aging Study (SLVHAS), an epidemiologic study among Hispanic and non-Hispanic white (NHW) elderly in rural southern Colorado, we found a prevalence of executive impairment of 33% using the Behavioral Dyscontrol Scale (BDS), a measure of the ability to engage in goal-directed activity. There was an excess of impairment among Hispanics that could not be explained by age or education. Here we report the effects of acculturation on BDS performance in that sample of 1,313 community-dwelling persons and nursing home residents aged 60 to 99. The sample was 57.6% female and 57.9% Hispanic. Mean age was 74.0 years; 33.7% of the sample showed impairment, with 16.4% moderately or severely impaired on the BDS. Unadjusted odds ratios showed Hispanics of all ages were more likely to be impaired (OR = 4.12, 95% CI = 3.16–5.35) or moderately/severely impaired (OR = 4.20, 2.91–6.08) than NHWs. Males and females did not differ. Greater prevalence of impairment was associated with older age and lower education; 46% of nonagenarians were severely or moderately impaired, as were 33% of those with 8 years of schooling or less. Models adjusted for age and education decreased the Hispanic excess by about one-half. After including acculturation in the models, the Hispanic excess was no longer significant (ORs = 1.54 and 1.24, respectively; 95% CIs include 1.0). Neither language nor a culturally biased instrument are likely explanations for the Hispanic excess. An age by ethnicity interaction on the BDS suggests that

a generational cohort effect may account for the results, although the nature of this effect is unknown.
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T. WARD. Neuropsychological Assessment in the Caribbean, Cross-Cultural Issues in the Use of Popular Instruments.
Neuropsychology is a small profession within the Caribbean, which is emerging as a part of the overall development of the psychology discipline within the region. In the early stages of this process, the small number of practitioners have to work with severe resource constraints. Thus, while it is highly desirable that standard instruments such as the Weschler Adult Intelligence Scale (WAIS) should be redesigned and normed in the Caribbean, in reality this is unlikely to happen for some considerable time. Thus, practitioners have to use such tests, trying to be careful about any cross-cultural differences which may modify interpretation. This paper briefly reports several issues which have arisen during cognitive assessments carried out at the University of the West Indies. As an example, the final item from the WAIS–R picture completion task is unusual to a Caribbean audience. In tests with university students, only 1of 129 students correctly suggested that the snow was missing from on top of the wood pile. The Rivermead Behavioral Memory Test is a widely used test of everyday memory functions. We describe how the Caribbean population frequently encounter problems with naming some of the line drawings, and how we have avoided this in version (a) by substituting items from the other versions. We also suggest that the face recognition task is culturally biased, and describe how this has been overcome by the use of locally produced stimuli.
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T. WARD. The Development of Measures of Executive Functioning for Use in the Caribbean.
The Caribbean is a small developing region in which most professionals experience severe resource constraints in carrying out their duties. This is no less the case for neuropsychologists. At the University of the West Indies (UWI) the small psychology team has begun a process of developing test materials for use in the region. In many cases, this involves slightly modifying and renorming existing measures such as the Weschler Adult Intelligence Scale. Where possible, however, the approach is to develop new versions of existing tests which can then be distributed royalty-free to workers in the region. This paper describes the development of 2 new versions of widely used measures of executive functioning, the Stroop and Trail-Making tests. The UWI Stroop consists of 2 parts, neutral color naming and color word naming. Each part has 20 items. The UWI trails test consists of 2 parts, the first requiring the connection of 25 numbers and the second requiring number–letter alternation. Both versions were carefully designed so that the distance traveled by the pen is identical across the 2 parts. Preliminary norms are presented based upon assessment of 96 volunteers ranging in age from 18 to 79. All measures were significantly correlated with age, and as one might predict, if they both measure aspects of executive function, there was a sizable and significant correlation between performance on the UWI Stroop task with words and the UWI Trails task Part B.
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S.E. O'BRYANT, L. JOHNSON, & R. J. McCAFFREY. The Development of the Cross Cultural Test of Face Recognition.
Tests of face recognition have been utilized in the assessment of neurological impairment due to a variety of causes, including TBI and dementia (Rapcsak, Polster, Comer, & Rubens, 1994; Wilson, Kaszniak, Bacon, Fox, & Kelly, 1982; Diesfeldt, 1990). The majority of the tests currently used that assess face recognition, however, consist of only Caucasian photographs, which makes them subject to cultural bias, namely the cross-race recognition bias (Barkowitz & Brigham, 1982). Currently, there are no tests of face recognition that were created to address this problem. The present study was conducted in order to create a test of cross cultural face recognition. Photographs were taken of African American, Asian, Caucasian, and Hispanic individuals in order to develop the Cross Cultural Test of Face Recognition (CCTFR). The CCTFR was then administered to 35 Caucasian and 10 African American participants. There was no own-race recognition bias present in the CCTFR for either the African American or Caucasian participants indicating that CCTFR may prove to be a cross cultural test of face recognition without any inherent cultural biases.
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D. BADENES, M. HERNANDEZ, M. LOZANO, S. MUNTAL, S. RAMOS, J. VILALTA, E. IZQUIERDO, O. PUIG, N. CERULLA, V. MORANTE, G. CHICO, S. LOPEZ-POUSA, & M. AGUILAR. Mattis Dementia Rating Scale: Clinical Validity in Alzheimer's Disease in Spanish (Spain) Population.
Introduction: The Mattis Dementia Rating Scale (MDRS) is an instrument designed to assess the nature and severity of dementia. It consists of 5 scales (Attention, Initiation/Perseveration, Construction, Conceptualization, and Memory). We propose to carry out a pilot study to evaluate the efficiency of the MDRS to detect Alzheimer's disease in Spanish patients. Currently no normative data for elderly Spanish population exist. *Methods:* MDRS was administered to 66 subjects, of whom 34 had been diagnosed of Alzheimer's disease according to NINCDS-ADRDA criteria, with MMSE score lower than 24, GDS stage between 3 and 5. The control group was formed by 32 healthy elderly subjects with an MMSE higher than 24 and a GDS stage of 1. There were no significant differences in age, gender, or educational level in both groups. MRDS was simultaneously administered by an observer and an interviewer to 10 subjects. *Results:* The concordance of the global scores between examiners was $W = 0.944$ ($p < .001$). The ROC area was the area under the curve of 0.945 ($SD = 0.031$). The optimal cut-off, which had the best efficiency was 124/125 with a sensitivity of 0.937 ($IC = 0.821$–0.990), a specificity of 0.937 ($IC = 0.811$–0.989), a positive predictive value of 0.941 ($IC = 0.884$–0.998) and a negative predictive value of 0.937 ($IC = 0.879$–0.995). The reliability intervals were done with $1 - \alpha$ (95%). *Conclusions:* The MDRS is an effective and reliable tool to detect Alzheimer's disease in an elderly Spanish population.
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D.A. PINEDA, F. LOPERA, F.X. CASTELLANOS, J.D. PALACIO, & G.C. HENAO. Definite ADHD Prevalence in "Paisa" Community.
Prevalence of attention deficit hyperactivity disorder (ADHD) in the "Paisa" Colombian population has been estimated to be between 16.1 to 17.1%. However, these data have been challenged because of the inclusion of children with limited FSIQ and mild motor disabilities. The objective was to determine the definite prevalence of ADHD in "Paisa" children and adolescents, using a cognitive assessment. A randomized sample of 4-to-17-year-old children and adolescents (176 males and 154 females) was selected from the schools of Manizales (Colombia). Children from special education were excluded. Several rating scales (parents/teachers, unidimensional/multidimensional) for the diagnosis of ADHD were applied. The diagnosis of ADHD was confirmed by a semi-structured psychiatric and neurological interview. Using cognitive assessment, children with FSIQ between 71 and 84 were recoded as borderline intellectual functioning (BIF), and children with a history of mild motor retardation and/or PIQ lower than 71 were recoded as developmental coordination disorder (DCD). Both were excluded from the ADHD group. When children with BIF DCD were excluded the definite prevalence was 11.5%, combined type was 6.4%, inattentive was 4.8%, and hyperactive impulsive type was 0.3%. Distribution by sex was male 18.4% and female 8.7%,

OR = 2.1 (95% CI: 1–4.6, $\chi^2 = 4.2$, $p = .04$). Prevalence of BIF was 5.8%, DCD was 3.0%, and mild mental retardation (MMR) 3.9%. ADHD prevalence was not different by socioeconomic status (SES) suggesting that environmental conditions did not influence this high prevalence. However, BIF, DCD, and MMR were significantly more frequent in the lower SES.

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D.A. PINEDA, M.A. RESTREPO, R. J. SARMIENTO, J.E. GUTIERREZ, S. VARGAS, Y.T. QUIROZ, & G. HYND. Volumetric MRI of Caudate Nucleus Head in Colombian ADHD Children.

MRI-based morphometric studies of the caudate nucleus (CN) have reported reversal asymmetry and alterations of the size, suggesting a striate cortical disorder related to attention deficit hyperactivity disorder (ADHD). The aim of this study was to evaluate whether alterations of the asymmetry and size of the CN head exist in a sample of well controlled seven-to-eleven-year-old Colombian children, with different types of ADHD. Two groups of cases: (1) ADHD of combined type (ADHD/+H) and (2) ADHD of inattentive type (ADHD/−H), and one control group, were selected. Multiple methods (psychological, psychiatric, neuropsychological, and neurological) for assessing ADHD were used to confirm the diagnoses. Participants with a history of language disorder, learning disabilities (LD), depression, and other major neurological and psychiatric conditions were excluded. All groups had 15 children, matched by sex (7 male/8 female), age (seven to eleven years old), socioeconomic strata (SES), and grade. Height, weight, head circumference (HC), and encephalic index (EI) were statistically controlled. Three T1 weighted volumetric (3D) MRI-slides of the CN head were obtained with a 1.5 Tesla Gyroscan apparatus. The control group had a significantly higher FSIQ than the ADHD/+H and ADHD/−H groups (ANOVA, $p < .001$). Volume of the left CN head was significantly bigger than the right (L > R) in all groups ($p < .001$). There were no significant differences when ANOVA for comparing groups was performed. These discordant results with other previous studies are discussed.

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D.A. PINEDA, V. MERCHÁN, M. ROSSELLI, & A. ARDILA. Executive Function in Colombian Young University Students.

Mathematical models using factor analysis have supported the multiple dimensional structure of executive function (EF). The objective was to determine the factor structure of executive function. 100 participants of both genders (age 16 to 21 years old and normal full scale IQ), were selected in a randomized and representative approach from private universities of Medellín, Colombia. They were students pursuing verbal, visuospacial, and mathematical careers. An executive function assessment battery was applied, which included: Wisconsin Card Sorting Test (WCST), Trail Making Test (TMT) A and B, verbal fluency test (FAS) by phonologic and semantic guidance, and Stroop test. *Results:* An orthogonal structure of 5 factors was found, which explained 74.9% of the variance. Factor 1 was formed by WCST variables (organization and flexibility), and explained 25.8% of the variance. Errors from the Stroop reading and naming loaded to factor 2, which explained 17.3% of the variance. Factor 3 was the time for executing the Stroop test, and explained 13.1% of the variance. Factor 4 was the time of TMT A and B (10.1%). Factor 5 was verbal fluency (8.5% of the variance). *Conclusion:* Executive function in young university students is comprised of multiple cognitive dimensions.

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S.L. SCHMIDT, A.L.N. CARVALHO, & A.C. MANHÃES. Empirical Analysis of an Inventory for Behavioral Problems of Brazilian Students (Bibep).

Those who rely only on their clinical judgment often fail to identify children with behavioral problems. In Brazil, due to poor education of parents from low level economic classes, there is a need to collect information on children. The 58 items of the BIBEP (Brazilian Inventory for Behavioral and Educational Problems) was developed to be used in school settings. Here, we studied internal reliability and construct validity of the BIPEP, and the relationship between BIPEP scores and performance in a computer-based Brazilian CPT. Subjects were 238 children (119 boys and 119 girls) aged 6 to 17 years. The internal consistency of the questionnaire was evaluated by using Cronbach's alpha. An orthogonal varimax rotation that maximizes the variance of the squared loadings for each factor was used to find the simplest possible factor structure. Only factors that account for variances greater than 1 and the most highly correlated variables for each factor were included. The relationship between teachers' scores on the BIBEP and student's performance on the CPT was analyzed by computing Pearson's correlation coefficients. There is no internal discrepancy in the item content of the questionnaire (alpha = 0.9694). The number of items of the checklist could be expressed on a smaller number of factors (Hyperactivity/Impulsivity, Inattention, Social Isolation, Disruptive Behavior). Statistically significant correlations were found between the BIBEP teacher questionnaires and all variables of the Brazilian CPT ($p < 5\%$). The BIBEP contains a useful pool of items for defining and potentially better understanding children with attentional disorders.

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A. ROOZBEHANI. Romantic Science as a Dynamic Research Method in Neuropsychology.

Classical science which intends to give general laws following experimental methods has faced several criticisms. Many years ago, Vigotsky argued that research methods in psychology led to crisis in this area. The solution to this crisis, according to Vigotsky, lies in "tools and result" methodology. Concerned about the crisis, Alexander Romanovich Luria formulated an approach called "Romantic Science," in which he combined experimental and descriptive methods in human "activity" (not behavior) study. Some of his worthwhile books like *The Man With a Shattered World* and *The Mind of a Menemonist* are written in this manner. Later, in the U.S., Oliver Sachs, following Luria's Romantic Science, elaborated on the importance of abnormal brain–behavior (activity) relationship. Romantic scholars avoid following the path of reductionism, which is the leading philosophy of the classical group. They do not want to restrict psychology to a laboratory science, rather they attempt to apply it to people's everyday lives. If we assume that human "activity" (rather than "behavior") is dynamic, that is, "it is becoming" rather than "being", then it should be studied in its dynamic process. Consequently, dynamic methods such as Romantic Science as alternatives to classical science are needed in neuropsychological research, particularly in cultural neuropsychology.

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Paper Session 14/1:30–3:15 p.m.

EXECUTIVE FUNCTION

M. LEWIS & L.S. MILLER. Impaired Functional Ability in Older Adults Relates to Decrements in Executive Control.

The manner in which 4 cognitive domains included in the construct of executive control functioning (ECF) exerted their influence on performance-based functional ability was investigated. Sixty older adults were administered tests of performance-based and observational functional ability, and neuropsychological tests measuring attention, planning, cognitive fluency, and cognitive flexibility. Simple regression analyses demonstrated the presence of relationships between functional ability and each domain of ECF. Deficits in attention were most strongly related to functional impairment ($F(1,59) = 49.309$, $p < .001$), followed by planning deficits ($F(1,54) = 33.707$, $p < .001$), fluency impairment ($F(1,59) = 34.879$, $p <$

.001), and deficits in cognitive flexibility ($F(1,53) = 10.794$, $p < .05$). Additional analyses using stepwise regression, however, indicated that a model including impairments in planning and cognitive fluency best predicted performance-based functional decrement among participants (multiple $R = .68$, $F(2,51) = 21.13$, $p < .01$). Results indicated that attention can have strong decremental effects on functioning when significantly impaired. Given that only 10% ($N = 6$) of participants demonstrated more than minor attentional deficits, attention may remain relatively intact in the presence of marked deficit in other ECF domains, such as planning and cognitive fluency, and serve as a threshold variable for functional impairment. Although planning and fluency incorporate attention, analyses suggested that when unique skills inherent in such constructs break down, functional performance is compromised. Findings underscore the import of ECF in daily living.

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K. LOCKWOOD, G. ALEXOPOULOS, & W. VAN GORP. Executive Dysfunction and Disability in Geriatric Depression.

This study was designed to examine the relationship between neuropsychological functioning and disability in geriatric depression. The sample was comprised of 40 participants (20 patients with major depressive disorder and 20 psychiatrically normal participants). An extensive neuropsychological battery was administered to all participants, as was an assessment of instrumental activities of daily living (IADL). Results from statistical analyses revealed significant correlations between tasks of executive/psychomotor function and IADL impairment in depressed older adults. In contrast, IADL impairment was not associated with performance on tasks of selective attention, sustained attention, or verbal/nonverbal memory for depressed patients. The strong association between deficits in complex daily living skills and impairment in functions putatively mediated by frontal systems supports the hypothesis that striatofrontal dysfunction is a primary source of behavioral disability in geriatric depression. Identification of specific executive processes necessary for adequate domestic living skills is essential to inform and guide interventions within a disability model.

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O. PIGUET, L. RIDLEY, D.A. GRAYSON, R.L. TATE, H.P. BENNETT, T.C. LYE, H. CREASEY, & G.A. BROE. White Matter Lesions Are Not Related to Executive Dysfunctions in Elderly Individuals.

In nondemented elderly individuals, executive functions (EF) have been described to show larger age-related change compared to other cognitive abilities. Periventricular and deep white matter lesions (WML) identified on brain magnetic resonance imaging (MRI) are also positively associated with age and are reported in greater severity in the frontal region. Between these two types of lesions, there is suggestion for the periventricular WML to be more specifically associated with poorer cognition. The relations between WML and EF performance were investigated in a group of randomly selected elderly community dwellers (mean age = 86 years). Participants ($N = 123$) were recruited from the Sydney Older Persons Study 6-year review. Structural brain MRI was performed and the location and size of WML were recorded using semiquantitative rating methods. Nine tests of EF were administered as part of a larger battery of cognitive tests. Periventricular WML were present in all participants with a similar severity level. Deep WML distribution was more varied, the number of participants free of lesions ranging between 5% and 60% depending on the region. There was no evidence of a greater frontal severity for either type of lesion. Further statistical analyses failed to demonstrate significant relationships between WML severity and either EF performance or most demographic variables. These findings suggest that in this age group, WML may no longer be evidence of a pathological process and may not be responsible for cognitive change.

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D. J. CROCKETT, R. VERNON-WILKINSON, & D.M. CROCKETT. Clinical Utility of Scores Derived From the Trail-Making Test.

Using a large clinical sample ($n = 486$), we compared several derived scores from the Trail-Making Test to illustrate the impact of using derived scores to control for the effects of simple psychomotor speed on a dual-processing task. Untransformed Part A [$F(6,479) = 10.012$, $p < .001$] and Part B scores [$F(6,479) = 9.33$, $p < .001$] were strongly associated with membership in clinical groups even when the effects of demographic variables were controlled [$F(6,476) = 7.041$, $p < .001$, $F(6,476) = 5.889$, $p < .001$, respectively]. The difference between the time taken to complete Part A and Part B was related to group membership [$F(6,479) = 6.938$, $p < .001$] even when the effects of demographic variables were controlled [$F(6,476) = 3.894$, $p < .001$]. The ratio between scores on Part A and Part B had a weaker relationship to membership in clinical groups [$F(6,479) = 2.710$, $p < .013$] that did not withstand the effects of adjusting for the effects of demographic variables [$F(6,476) = 2.098$, $p < .052$]. The product of the standardized performance on Part A and Part B was related to group membership [$F(6,479) = 3.592$, $p < .002$] and remained significant even when the effects of demographic variables were controlled [$F(6,476) = 3.106$, $p < .005$]. The total amount of time taken to complete this test was also related to group membership [$F(6,479) = 11.253$, $p < .001$] and that association withstood the effects of controlling for demographic differences [$F(6,476) = 7.309$, $p < .001$]. These results illustrate the difficulties of controlling for a dependent variable that has a significant relationship to the criterion variable.

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S. McDONALD & S. FLANAGAN. TASIT: A New Test for Assessing Deficits in Social Perception.

Social skills are commonly impaired following traumatic brain injury (TBI), autism, schizophrenia, learning disabilities, and other conditions. Even so, little emphasis has been placed upon the role of social perception in social skills deficits despite all of these groups demonstrating poor recognition of social cues. We present here information concerning the reliability and validity of our recently developed test "The Awareness of Social Inference Test" (TASIT). TASIT comprises videoed vignettes with standard response probes and alternate forms. There are 3 sections. (1) The Emotional Evaluation Test (EET) comprises 28 vignettes of natural emotional expressions. (2) The Social Inference–Minimal test (SI–M) comprises 15 vignettes of ambiguous conversational scripts enacted either sincerely or insincerely (i.e., sarcastically, opposite in meaning to the literal sense). (3) The Social Inference–Enriched test (SI–E) comprises 16 vignettes in which all scripts are literally untrue, half being lies and half reflecting sarcastic comments. Additional visual or verbal cues are provided to assist interpretation. TASIT was given to between 134 (EET) and 253 (SI tests) normal speakers from a range of demographic backgrounds who performed near ceiling on all subtests. The alternate forms were equivalent. TASIT was given to 12 people with severe TBI who were compared to 12 matched controls. Results were consistent with the literature. TBI subjects were impaired on emotion generally with particular deficits interpreting anxiety. While they interpreted sincere conversational exchanges normally they had significant difficulty understanding the meaning of lies and sarcasm. TASIT is thus simple for normal speakers and yet sensitive to social perception deficits.

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M. WELSH, M. HUIZINGA, M. GRANRUD, J. COONEY, C. ADAMS, & M. VAN DER MOLDEN. A Structural Equation Model of Executive Function in Normal Young Adults.

Individuals who have sustained focal prefrontal cortical damage exhibit deficits in goal-directed behavior that have been referred to collectively as executive function (EF). Currently, there is no single, accepted theoretical account of EF and its component processes. This study was designed to

empirically validate one theoretical formulation of EF by means of structural equation modeling (SEM). The proposed model of EF included the correlated constructs of Working Memory (Letter-Number Sequencing, Spatial Span) and Inhibition (Continuous Performance Test, Go-No-Go), each of which predict variance in 3 "higher order" constructs: planning (Tower of London, Mazes), flexibility (Stroop, Task-Switch), and rule induction (Tower of Hanoi, Matrix Reasoning). Three hundred male and female, normal, college student volunteers (M age = 20 years) were recruited from 2 universities in Colorado and in the Netherlands and administered a battery of 10 tests (35 indicators). SEM analyses using the EQS software led to a slightly revised model with a chi square of 190.94, $p <$ .0001. Although the model does not meet statistical criteria for a good fit, the CFI = .933, and RMSEA = .04 suggest that it is an acceptable first approximation. This structural model of EF includes moderately correlated constructs of working memory and inhibition. Working memory explains more variance in planning and rule induction constructs than does inhibition; whereas, working memory and inhibition explain a relatively equal proportion of variance in the flexibility factor. Finally, there is a strong correlation between the unexplained variances in the planning and rule induction factors.

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R.C. MULLIGAN, J.M. VONGHER, J. VASSILEVA, S. DURGERIAN, M. FISCHER, M. SEIDENBERG, B. J. SALMERON, E.A. STEIN, & S.M. RAO. Methylphenidate and Working Memory in ADHD Adults: Effects of Dose and Memory Load.

Methylphenidate (MPH) is the most commonly prescribed pharmacological treatment for attention deficit hyperactivity disorder (ADHD). Although numerous studies have demonstrated MPH's positive effects on a wide range of ADHD-related behavior disorders, its effects on cognition are less well understood. Several neuropsychological studies have identified deficits in working memory and inhibitory control as the prominent cognitive features of ADHD. The N-back, a working memory task commonly used in functional neuroimaging studies, can be parametrically varied with respect to working memory load. The effects of MPH on ADHD subjects have not been studied as a function of dose and working memory load. This double-blind, placebo-controlled, counterbalanced study compared 3 doses of MPH (0 mg/kg, 0.2 mg/kg, 0.4 mg/kg) at 4 levels of N-back task difficulty (0-, 1-, 2-, and 3-back) in 7 ADHD adults (confirmed diagnosis in childhood) and 7 demographically-matched controls. Results indicated a significant group effect with ADHD subjects making greater errors than controls on the 1- and 2-back conditions (no group differences were observed at 0- or 3-back). For the 1- and 2-back conditions, ADHD subjects on the high MPH dose made significantly fewer errors than on the placebo or low dose conditions. No differences were observed between the ADHD and controls at the high dose of the 1-back condition; the difference at the 2-back condition was marginally significant (p = .04). These findings suggest that a 0.4 mg/kg dose of MPH improves or normalizes the working memory performance of ADHD adults at low to moderate levels of working memory load.

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Paper Session 15/1:30–3:15 p.m.

ALZHEIMER'S DISEASE

R. DAVIS, P. MASSMAN, & R. DOODY. WAIS–R Factor Structure in AD: Comparison of Alternative Models and Assessment of Generalizability.

The WAIS–R continues to be used in neuropsychological evaluations of individuals with probable Alzheimer's disease (AD), but its factor structure in this population is unknown. In clinical samples, different numbers of factors or patterns of subtest loadings may emerge that could affect interpretations of WAIS–R results. In this study, we used confirmatory factor analyses (CFA) to compare 5 WAIS–R factor models in a large sample of AD patients (N = 516), and then assessed the generalizability of these models in 3 pairs of subsamples: males (n = 180) *vs.* females (n = 336), patients at higher (MMSE ≤ 20; n = 259) *vs.* lower (MMSE ≥ 21; n = 253) levels of dementia severity, and patients with more (≥ 13 years; n = 248) *vs.* fewer (≤ 12; n = 268) years of education. The 5 models tested were: (1) a 1-factor model (g); (2) a 2-factor model (VIQ, PIQ); (3) a 3-factor model including Verbal Comprehension (VC), Perceptual Organization (PO), and Freedom from Distractibility (FD) factors; (4) a 3-factor model in which Digit Symbol loaded on PO, rather than FD; and (5) a 3-factor model in which Digit Symbol loaded on both PO and FD. The results favored a 3-factor model in which Digit Symbol loaded on PO, rather than FD. Moreover, using multiple-group CFA, this model was found to fit the data best among all of the subsamples. These findings were surprisingly consistent, particularly when replicated among the severely demented AD patients, for whom one might expect a single, global factor to best encapsulate cognitive functioning.

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M. REGER, R. WELSH, G.S. WATSON, B. CHOLERTON, C. GLEASON, L. BAKER, & S. CRAFT. The Relationship Between Cognitive Functioning and Driving Ability in Alzheimer's Disease.

This meta-analysis summarizes the literature on the relationship between neuropsychological functioning and driving ability in subjects with Alzheimer's disease. The results from 21 primary studies were aggregated based on driving measure (on-road tests, nonroad tests, or a caregiver's report of driving ability) and cognitive domain tested (mental status, attention/concentration, visual construction, memory, executive functions, language, and all tests combined). When on-road and nonroad tests were used, there was a significant relationship between neuropsychological functioning and driving ability in all cognitive domains with mean r's ranging from .11 to .67. There was not a significant relationship between caregiver's report of driving ability and neuropsychological functioning in 4 cognitive domains (attention/concentration, memory, executive functioning, and language). The remaining 3 effect sizes based on a caregiver's report ranged from .23 to .42, with 2 of the 3 effect sizes falling in the small range. When studies with control subjects were excluded to examine cognitive tests' ability to predict driving skills within a group of demented subjects, all effect sizes were small. Implications for basing driving recommendations on neuropsychological test scores are discussed. Overall, the literature suggests that when the goal is to identify which demented subjects are at-risk drivers, neuropsychological tests explain statistically significant, but small amounts of variance in driving ability.

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L. MURRAY. Linguistic and Cognitive Deficits in Depression *versus* Early Alzheimer's Disease.

The purpose of this study was to help resolve the diagnostic dilemma of distinguishing the reversible cognitive impairments or pseudodementia associated with depression from the irreversible dementia associated with early or mild Alzheimer's disease (AD) in the elderly. Whereas previous research has inordinately centered on contrasting the memory profiles associated with depression *versus* early AD, methodological limitations have compromised the results of the few empirical studies that have examined the linguistic and other cognitive abilities of these 2 patient populations. Consequently, the current study required age-matched groups of elderly adults with depression, early AD, or no psychiatric or neurological problems to complete a comprehensive battery of basic and complex attention, language, and memory tests that had been developed relatively

recently (e.g., Test of Everyday Attention by Robertson et al., 1994) and/or had not been used in prior investigations (e.g., Test of Language of Competence by Wiig & Secord, 1989). ANOVA and discriminant function analyses indicated that tests of complex attention functions (e.g., attention switching, divided attention), working and episodic memory, and high-level language comprehension and production (e.g., generation of multiple interpretations of ambiguous sentences: identification of plausible inferences) were most useful for identifying quantitative and qualitative performance differences between the depressed and early AD groups. These findings suggest that use of a small subset of high level cognitive tests may represent a possible solution to the applied quandray of differentiating depression from early AD in elderly patient populations.
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M.E. O'CONNELL & H. TUOKKO. The 12-Item Buschke Memory Task: Appropriate for Use Across Levels of Impairment.
The identification of measures for monitoring cognitive functions as older adults move from independent living to facility care is of utmost importance with respect to care planning. We examined the utility of a 12-item free and cued recall selective reminding memory task (Buschke, 1984) that controls encoding and evaluates the impact of cuing on performance. Using cross-sectional data from the Canadian Study of Health and Aging (CSHA-1), it was observed that 91% of persons residing in institutions and 96% of persons residing in the community who took part in the neuropsychological examination were able to complete all trials. Various measures from the 12-item memory task (e.g., delayed total recall = free recall plus cued recall) differentiated between older persons of varying levels of impairment: Individuals living in the community performed better than those in institutions ($t = -4.30$, $p < .001$); individuals with no or mild impairment on activities of daily living (ADLs) performed better than individuals with moderate or severe impairments of ADLs (e.g., $F = 35.85$, $p < .001$); among persons diagnosed with dementia, individuals with mild cognitive impairment, defined by age and education corrected cut-off scores on the Modified Mini Mental Status Exam (3MS; Teng & Chui, 1987), performed better than those with moderate to severe cognitive impairment (e.g., $t = 4.130$, $p < .001$). This easily administered and well-tolerated memory measure appears ideal for use when following persons across levels of functioning.
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J. GALLO, J. DODSON, M. GROSSMAN, & G. GLOSSER. Semantic and Associative Knowledge Effects on Word Reading in Alzheimer's Disease.
Semantic memory impairment is a well-recognized feature of the dementia in Alzheimer's disease (AD), yet numerous studies have shown facilitation (priming) between "semantically" related words. One explanation of this apparent paradox is that the semantic memory impairment in AD is selective for only certain types of semantic knowledge. Although it appears that knowledge about word *meanings* is disrupted in AD, there are indications that knowledge abut word *associations* is relatively spared. To test this hypothesis 24 moderately demented AD patients were administered a task involving oral reading of words with irregular spelling-to-sound correspondence. Words were presented once individually and once with a related word. In half of the paired trials the 2 words were related both semantically and associatively (*pound–ounce*), and in half they were related only semantically (*tomato–onion*). Whereas reading accuracy did not differ for words of the 2 classes when they were presented singly, in paired reading there was a significant and consistent advantage for word pairs that were both semantically and associatively related. These results support the hypothesis that word association knowledge, in contrast to word meaning knowledge, is a major determinant of facilitated lexical processing in AD.
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B. J. HALLAM, W.S. BROWN, J.G. BUCKWALTER, C. ROSS, & E. BIGLER. Functional Channels of the Corpus Callosum: Evidence from Alzheimer's Disease Patients.
This study investigated relationships between the size of subregions of the corpus callosum (CC) and the neurocognitive performance of older adults. Subjects represented a continuum of neurocognitive functioning from healthy, to mild cognitive impairment, to probable Alzheimer's disease. CC outlines were obtained from 186 midsagittal MRIs and divided into 99 widths. Factor analysis of width measures revealed 10 contiguous callosal subregions. Sizes of the callosal subregions for each subject were correlated with neurocognitive performance revealing that larger callosal subregions resulted in better neurocognitive performance. Bivariate correlations demonstrated that the size of some portion of 2 large callosal regions was significantly correlated with performance on every test. One region encompassed the isthmus and anterior splenium, and the other, the rostrum and genu. However, hierarchical regression and reduced form equations revealed that (after controlling for age, gender, education, white matter lesions, and variations in head size) the size of the posterior isthmus and anterior splenium accounted for all of the significantly correlated variance on tasks of language, praxis, visuomotor skill, verbal memory, and global cognitive functioning. This CC region contains fibers interconnecting the temporal lobes and posterior parietal lobes (Pandya & Seltzer, 1986), cortical areas known to deteriorate significantly in dementing illness and integral to the tasks of higher cognition utilized in this study. These results suggest that dementia-related decline in performance is most clearly associated with atrophy in the posterior corpus callosum. Thus, posterior callosal morphology provides an index of cortical integrity and related neuropsychological functioning in older adults with dementing illness.
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R. DAVIS, T. ATCHISON, P. MASSMAN, & R. DOODY. Growth Curve Analysis of Decline in Instrumental Activities of Daily Living in AD Patients.
Patients with Alzheimer's disease (AD) exhibit decline in IADLs at widely varying rates. Latent variable growth curve modeling (LGM) is ideally suited to study individual differences in rates of decline. This study used LGM to predict individual growth curves for IADLs in 103 probable AD patients who underwent a baseline neuropsychological examination (including IADLs) and for whom IADLs were measured at 12 and 24 months after baseline. An initial run of the model with 3 IADL time points fit the data well, with both the intercept and slope variables (representing initial status and rate of change) exhibiting significant variance. A covariate model including age, sex, education, and dementia severity (MMSE) was then tested. MMSE scores predicted both initial status and rate of change, and age predicted initial status; sex and education did not predict either variable. The main analysis tested the ability of 5 classes of neuropsychological variables to predict initial status and rate of change in IADLs: (1) semantic (Vocabulary); (2) visuoconstructional (Block Design); (3) attention [Verbal Series Attention Test (VSAT)–Time]; (4) verbal memory (Logical Memory I); and (5) visual memory (Visual Reproduction I) functions. With all variables considered simultaneously, age, MMSE, and VSAT–Time predicted initial status. Moreover, MMSE, Block Design, VSAT–Time, and Logical Memory I predicted rate of change; the latter 3 variables predicted rate of decline above and beyond MMSE scores and age. AD patients who exhibit deficiencies in these functions tend to decline faster than patients in whom these functions are less compromised at baseline.
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Symposium 11/1:30–3:15 p.m.

CEREBROVASCULAR DISEASE AND DEMENTIA: DEFINING THE ROLE OF LACUNAR INFARCTION

Organizer and Chair: Bruce R. Reed

B. REED, S. TOMASZEWSKI-FARIAS, J. KRAMER, & D. MUNGAS. Cerebrovascular Disease and Dementia: Defining the Role of Lacunar Infarction.

Modern brain imaging has greatly improved our ability to detect cerebrovascular disease (CFd) *in vivo* but our understanding of the cognitive consequences of CVd lags, particularly in "subcortical" cases. One prominent hypothesis is that lacunes play a critical pathogenic role by disrupting cortico-thalamo-cortical loops. This symposium critically examines the lacunar hypothesis using data from a program project. (The Aging Brain, H. Chui, PI) on vascular contributions to dementia. First, Dr. Kramer reports impaired executive function in subjects with lacunes who were ostensibly normal (by general neuropsychological testing and observer report). Second, Dr. Tomaszewski-Farias reports effects of lacunar infarcts and white matter lesions (WML) on measures of memory and executive function in cognitively normal, impaired, and demented individuals. Next, Dr. Reed describes findings from PET studies of cortical glucose metabolism that support the idea that lacunes affect cortical metabolism, predominantly in dorsolateral frontal cortex, but which in addition suggest a strong generalized effect of WML. Dr. Mungas then presents large-sample analyses of the relationship between segmented MRI and neuropsychological scales. His analyses suggest that the effects of lacunes are modest compared to the effects of WML, hippocampal atrophy, and cortical atrophy. Dr. Reed concludes by presenting clinico-pathologic correlations from 35 autopsied cases. We suggest that while lacunes affect cognition, particularly executive function, the lacunar hypothesis is inadequate to account for cognitive impairment in patients with small vessel CVd; WML are important as is, surprisingly, hippocampal and cortical atrophy that are not necessarily attributable to AD.

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J.H. KRAMER, B.R. REED, D. MUNGAS, M. WEINER, & H.C. CHUI. Cognitive Sequelae of Clinically Silent Strokes.

Imaging studies of community-dwelling elderly have indicated that around 20% of these nondemented individuals have evidence of lacunar infarcts. The purpose of this study was to assess the potential impact of these infarcts on cognitive functioning, and explore possible underlying mechanisms. Inclusion criteria were a CDR of 0 *and* a clinical rating from project investigators as cognitively normal. The resulting sample consisted of 118 subjects: 30 cases with one or more subcortical lacunes, and 78 without evidence for subcortical lacunes. The groups were comparable in terms of age, education, total Mattis DRS score and male:female ratio. The Lacune group had a mean total lacunar volume of .70 cc and a significantly greater volume of white matter signal hyperintensities (WMSH). Groups were compared on measures of memory, executive functioning, language, and spatial ability. The Lacune group performed significantly less well than the Non-lacune group on delayed visual memory, the Initiation-Perseveration subscale of the DRS, and the Token Test. Regression analyses were carried out to assess the relative contributions of lacunar volume, WMSH, and hippocampal volumes on cognitive abilities. Lacunar volume was the best predictor of Initiation-Perseveration (R^2 = 22.8), followed by WMSH (ΔR^2 = 8.7). Lacunar volume was the only predictor of the Token Test (R^2 = .10). In contrast, memory performance was predicted by hippocampal volume (R^2 = 7.5) and WMSH (ΔR^2 = 5.6) but not lacunar volume. Results indicate that "silent infarcts" produce cognitive changes, and while the mechanisms of the changes are complex, subcortical infarcts directly interfere with executive functioning by disrupting subcortical-frontal loops.

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S. TOMASZEWSKI-FARIAS, D. MUNGAS, B.R. REED, & W.J. JAGUST. Memory and Executive Correlates of Subcortical Cerebrovascular Disease.

Previous studies examining the neuropsychological profiles of individuals clinically diagnosed with either cerebral vascular disease (CFd) or Alzheimer's disease (AD) have found differences in memory and executive functioning. Imaging studies have also examined the relationship between radiological white matter abnormalities and cognitive functioning. The purpose of this study was to examine how quantitative measures of subcortical CVd relate to memory and executive function. Measures of CVd included the presence or absence of lacunar infarcts as well as a quantitative, segmented MRI measure of white matter lesions (WML). Participants were 228 individuals, 87 with radiological evidence of one or more lacunes. The sample included a broad range of overall cognitive functioning and degree of white matter abnormalities. Indices of memory were taken from a list learning task, while executive functioning was measured using the Initiation-Perseveration scale from the Mattis DRS. WML but not presence/absence of lacunes was a significant predictor of executive and fluency measures. A similar pattern emerged for general memory measures including total recall across learning trials as well as both free and cued short delayed recall. WML and presence/absence of lacunes made independent contributions to intrusion errors on delayed recognition, with increased intrusions in those without lacunes, but also increased intrusions associated with greater WML. WML effects did not differ according to presence/absence of lacunes. Findings suggest that CVd plays an important role in memory and executive functioning, with WML being a stronger predictor than lacunes. Results support the hypothesis that WML and AD have additive and independent effects on cognitive function.

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B. REED, J. EBERLING, D. MUNGAS, J. KRAMER, M. WEINER, & W. JAGUST. Lacunes and Cortical Function in a Diagnostically Heterogeneous Sample.

A prominent idea regarding the mechanisms of vascular dementia is that "strategic" lacunes interrupt cortico-thalamo-cortical loops critical to executive function. To test this hypothesis we performed positron emission tomography (PET) studies of cerebral glucose metabolism using the tracer FDG on 63 persons ranging from cognitively normal to demented, 29 of whom had radiologically identified lacunes (but no cortical stroke). We analyzed how normalized volumetric MRI measures—lacunar volume (LV), strategic lacunes (SLV, lacunes in caudate or thalamus), white matter lesions (WML), hippocampus (HV), and cortical gray matter (CGM)—relate to metabolism, and how metabolism relates to neuropsychological function. The neuropsychological scales were 3 psychometrically matched composite scales, Executive function (EXEC), Memory, and Global function. Analysis of regional glucose metabolic rates (rCMRglc) in the 35 subjects with input functions demonstrated a moderate association between SLV and rCMRglc in dorsolateral frontal cortex (DLF). In addition, substantially stronger relationships emerged between WML and rCMRglc in every region studied, the strongest (R^2 = .28) being that with DLF. Both DLF and orbitofrontal rCMRglc were positively associated with EXEC. Analysis of normalized regional count activity in the whole sample showed moderate relationships between DLF activity and both LV (but not SLV) and HV, and a strong (R^2 = .18) relationship of CGM to DLF activity. Normalized DLF activity was moderately associated with EXEC. These results suggest that WML, CGM, and HV also affect frontal function, often more strongly than do lacunes. Prefrontal cortex may be selectively vulnerable to multiple pathologies of ischemic and degenerative disease.

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D. MUNGAS, B.R. REED, W.J. JAGUST, J.H. KRAMER, M.W. WEINER, W.H. MACK, & H.C. CHUI. Quantitative MRI Predictors of Cognitive Status and Decline.

Hippocampal and cortical atrophy are generally considered to be the primary determinants of cognitive decline related to Alzheimer's disease

(AD), whereas subcortical vascular pathology is commonly believed to underlie these changes associated with subcortical cerebrovascular disease (SCVd). The purpose of this presentation is to examine volumetric MRI correlates of cognitive functioning using cross-sectional and longitudinal data in a sample with broad variability in SCVD and with cognitive function ranging from normal to demented. Independent variables were quantitative MRI measures of (1) presence and volume of lacunes within subcortical gray and white matter, (2) volume of white matter lesions (WML), (3) volume of cortical gray matter (CGM), and (4) hippocampal volume (HV). Dependent variables were neuropsychological tests measuring global cognitive function, memory, executive function, and language. In cross-sectional analyses, Lacunes accounted for a small percent of variance in cognitive measures, while WML was more strongly related. However, HV and CGM were by far the strongest predictors of cognitive function, and strength of these effects did not differ in those with and without lacunes. Longitudinal analyses showed that low baseline CGM predicted greater decline in individuals with and without lacunes. Low HV predicted decline only in those without lacunes, where AD is the presumed pathological substrate for cognitive decline. Even though lacunes are weakly related to cognitive function, they may be markers of a pathological process that has broader effects. Specifically, results suggest that cortical and perhaps hippocampal changes accompany SCVd, and are primarily responsible for cognitive decline associated with SCVd.
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B. REED, D. MUNGAS, J. KRAMER, W. ELLIS, H. VINTERS, C. ZAROW, W. JAGUST, & H. CHUI. Neuropsychological and Diagnostic Correlates of Autopsy-Defined Cerebrovascular Disease.
There are virtually no data on neuropsychological findings in autopsy-confirmed ischemic vascular dementia (IVD), partly because there is no neuropathological "gold standard" for the diagnosis of IVD. Here we report relationships between neuropsychological data, clinico-pathologic diagnosis, and the cerebrovascular disease (CVd) and cerebrovascular dementia (CVD) scales from *The Aging Brain* program project (H. Chui, PI). These pathology-derived scales quantify the total burden of ischemic lesions (CVd), and of vascular lesions in cognitively-critical structures (CVD). Subjects were 35 consecutive cases. At last visit 4 were cognitively normal, 9 were cognitively impaired, and 22 were demented (9 with Alzheimer's disease (AD), 5 with IVD, and 8 with mixed AD/IVD, by clinical criteria). The neuropathological work-up yielded CVd and CVD scores, Braak & Braak scores, and CERAD plaque ratings. Final diagnosis (incorporating clinical data) was made by consensus of clinicians and pathologists. The clinical and final diagnoses agreed in only 13/22 (59%) of the dementia cases. AD accounted for dementia in only 9 cases, although a lesser degree of Alzheimer pathology was often present. Lacunes were not the predominant vascular pathology. Neither CVD or CVd correlated with last Mini Mental State (MMS) score (median lag from MMS to death = 11 months). Individual cases demonstrate enormous variability in the proportions of AD and vascular pathologies, as well as in their correspondence with neuropsychology. We conclude that lacunes comprise only a fraction of the vascular pathology in these cases and the pathologies of AD and cerebral ischemia interact to impair cognition in ways that are not yet understood.
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Symposium 12/1:30–3:15 p.m.

QUALITATIVE APPROACHES TO CHILD NEUROPSYCHOLOGY

Organizer and Chair: Edith Kaplan

M. KINSBOURNE. Qualitative Approaches to Child Neuropsychology.
Neuropsychologists contribute to neuroscience by localizing functions and to neurology by localizing lesions. When brain mapping and imaging have been perfected, brain–behavior correspondences will become their province. The cerebral where and when of normal and even disordered mental operations will devolve to mapping/imaging technologies. When that happens, will the clinical child neuropsychologist still be able to make any unique contributions? This symposium will feature the potentially unique contribution of qualitative analysis to clarifying the nature of the child's selectively impaired mental operations. Kinsbourne will illustrate the power of error analysis with respect to ADHD test performance, how it can be quantified on-line, and how it speaks to the functional anatomy of the disorder. Liss, Garcia, and Fein will show that children with autism make errors which on qualitative analysis indicate that atypical factors limited their performance on certain tests, conclusions that could not have been deduced from quantitative scores alone. Wood will show how a qualitative distinction in reading errors turns out to foreshadow a deep neurogenetic process distinction between subtypes of dyslexia. Kaplan will close by extracting instances of the unique contribution of distinctions in error types from a new process-oriented test instrument which feature qualitative analysis (Delis-Kaplan Executive Function Sequence). From its individual perspective, each contribution supports the theme that the information that can be derived from the analysis of errors cannot be replaced by quantitative test results, or rendered obsolescent by psychophysiological technologies.
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M. KINSBOURNE. The Errors that ADHD Children Make.
ADHD children score poorly on many mental tests, but it may not be the cognitive process that the test allegedly measures that the child finds difficult. Using computerized tests of short-term memory and of impulse control, we demonstrate what kind of errors ADHD children make, and what task formats and conditions result in the most *versus* least success on a given test. On 3 tests requiring temporary restraining of responding, ADHD children responded prematurely. On stimulant therapy, they no longer differed from controls. Handwriting errors reflected undue haste (stimulant sensitive) and clumsiness (not stimulant sensitive). On a half-hour test of short time memory (STM) for paired associates (CPALT), ADHD children made a below-normal number of correct responses. This was due to variance (increased coefficient of variation) indicating attentional lapses, not limited STM. CPALT performance normalized, both on stimulant therapy and when the task was rendered salient (fat or self-paced, brightly colored stimuli, immediately reinforced). Salience and stimulant together did not further improve performance. ADHD deficits may not specifically implicate the mental operation tested, but result from multiple attentional lapses, absent intrinsically motivating test characteristics. Neuropsychological test results in ADHD may not have their usual localizing value. ADHD performance qualitatively resembles that of rats with accumbens lesions or general dopamine depletion. The results suggest reversibly impaired dopamine activity in the ventral tegmental-ventral striatal-orbitofrontal axis. They are consistent with, but expand upon, neuroimaging findings in ADHD.
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M. LISS, A. GARCIA, & D. FEIN. Qualitative Analysis of Performance in Children with Pervasive Developmental Disorders.
Qualitative analysis of neuropsychological data can be essential to understanding group differences. Two examples from children with pervasive developmental disorders (PDD) will be presented. First, children with PDD were given the Biber Test of Cognitive Estimation. This entails providing a reasonable answer to a question for which the specific answer is not known. It entails such processes as planning, accessing relevant knowledge, working memory, mental control, self-monitoring, and correction, that are considered to be executive functions. The PDD group scored significantly lower on the Biber than controls matched for general fund of information. Error analysis, however, indicated that many of the PDD children's errors were incorrect units, rather than incorrect numbers. This may reflect a deficit in language processing or in knowledge, in addition

to executive dysfunction. In the second study, fact memory and source memory (memory for the conditions under which a fact was acquired) was studied in PDD and mental-age matched groups. The PDD children showed disproportionate difficulty with the source memory, relative to the fact memroy, task. Qualitative analysis, however, revealed that the PDD children performed better than the controls at recalling nonsocial source cues (such as background room color) and were impaired relative to controls at recalling the face of the person imparting the information, suggesting that the controlling variable may be the specific nature of the source variable rather than the general process of associating material with its context.
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F. WOOD. New Processes to Underlie a Process Approach to Dyslexia.
We show that distinctions in the underlying neurogenetic bases of dyslexia are somewhat more were studied longitudinally, over 15 years (1) $N = 570$ epidemiologically selected normals and dyslexics (single word reading scores at or below the tenth percentile). (2) 185 family members, whose adult dyslexic probands were similarly defined retrospectively on childhood testing by June Orton. Beyond neuropsychological testing, population 2 has undergone positron emission tomography (PET) and genetic linkage studies. A phonemic awareness and verbal "skill" factor emerges, with strong linkages on chromosome 6 (overlapping with Inattentive-Only ADHD). These interact with similar but differently described variance on chromosomes 6 and 1. PET implicates the ventral temporo-occipital (lingual-fusiform) cortex for chromosome 6 "syndrome," with separate thalamic and posterior cingulate involvement in the chromosome 15 and 1 factors, respectively. Cross-modal association is adduced as central to reading, but in the lingual-fusiform, not the angular gyrus, region. It is modified by automaticity failures, partly thalamic and partly posterior cingulate. In population 1, common dyslexia tests imperfectly reflect this underlying process; "diagnosis" benefits when the underlying process is "reached" by the tests, beyond superficial manifestations. In particular, the chromosome 6 syndrome is characterized by phonological decoding error (of pronounceable, real, and nonwords), whereas the chromsome 15 "syndrome" more involves sight and recognition errors. Especially important is the cross-disciplinary range of dyslexic processes, from genetics to neuroimaging to behavior and education. That scope is the general case of "underlying processes."
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E. KAPLAN. Qualitative Analyses of Executive Functions.
The focus on neuropsychological profiles of cognitive functioning for the identification of distinctive neurocognitive syndromes assumes that global test scores are objective measures of underlying unitary mechanisms. That these tests are in fact multifactorial are best demonstrated by examining those standardized tests that purport to comprehensively assess higher-level cognitive functions, i.e., "executive functions." These cognitive abilities however draw upon more primary cognitive skills such as attention, perception, and language, and such higher levels of cognitive abilities as concept formation, inhibition, and cognitive flexibility, to generate higher levels of creative and abstract thought. Examples from the Delis–Kaplan Executive Function Sequence (D–KEFS) will serve to demonstrate the diagnostic utility of tests that permit an analysis of the multiple underlying components of a task, and the qualitative aspects of performance as well. (1) The clinical relevance of the D–KEFS Trail Making test parcels: (a) scanning; (b) motor speed; (c) sequencing of numbers; (d) sequencing of letters; and (e) the ability to maintain the set to serially alternate between 2 automatized series (numbers and letters) as well as qualitative errors, will be presented. (2) The D–KEFS Sorting Test quantifies the following key components of concept-formation and problem-solving ability: (a) initiating of problem-solving behavior; (b) verbal and nonverbal concept-formation skills; (c) ability to transfer concepts into action; (d) ability to express conceptual relationships abstractly; and (e) flexibility of thinking. Nonclinical and clinical data obtained during the national standardization will underscore the utility of a quantifiable process-oriented approach to the assessment of executive functions.
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Poster Session 6/3:00–5:30 p.m.

EPILEPSY AND ERP

N. WILDE, G.H. CHELUNE, B. HERMANN, M. HUNTER, D.W. LORING, R. MARTIN, & E. STRAUSS. Confirmatory Factor Analysis of the WMS–III in Patients With Temporal Lobe Epilepsy.
The factor structure of the Wechsler Memory Scale–Third Edition (WMS–III) was examined in a sample of patients ($N = 252$) with temporal lobe epilepsy. Five models based on the covariance matrix of the 11 primary subtests were evaluated. Omnibus fit indexes and individual parameter estimates were examined. Models that specified separate immediate and delayed constructs resulted in inadmissible parameter estimates suggesting model specification error. A 3-factor model in which visual and auditory memory subtests loaded on separate constructs (working memory, auditory memory, visual memory) provided the best fit of the data, although a 2-factor model (working memory, memory) was more parsimonious. As was demonstrated in analysis of the data from the standardization sample (Millis, 1999), the R^2 values for the Faces subtests were low for all 5 models evalauted here, including those that specified a separate visual memory factor. Thus, model fit was reevaluated after removal of the Faces subtests. In this case, fit differences were negligible between a 2-factor (working memory, memory) and a 3-factor model (working memory, auditory memory, visual memory). Overall, the results suggest that specifying a separate visual memory factor for the Family Pictures subtests alone or in combination with Faces provides little advantage for this sample in comparison with a 2-factor model. This was somewhat unexpected in light of the many individuals in this sample with lateralized dysfunction—a population for which one might have predicted separate auditory and visual memory factors.
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N.A. DONINGER & G. J. CHELUNE. Assessing Differential Rates of Change on Common Neuropsychological Measures.
Recent studies have demonstrated significant test-retest gains on neuropsychological measures among neurologically intact and patient groups; however, little attention has been given to whether patients show differential rates of practice compared to intact controls. This study directly examines the relative rates of test-retest performance on indices from the Wechsler Adult Intelligence Scale–Revised and the Wechsler Memory Scale–Revised between neurologically intact individuals ($n = 29$) and those with medically intractable epilepsy ($n = 51$). Initial group differences in test-retest change on intellectual and memory measures were confounded by education. Dividing the epilepsy group into high and low education subgroups yielded different results. Differential practice effects were not evident between intact controls and the epilepsy subgroup matched for education and baseline performance, whereas significant differences in test-retest performance were observed between the intact controls and the low education epilepsy group. Given the expected effects of regression to the mean, the practice effects noted for the neurologically intact group on the Visual Memory, Delayed Memory, and Performance IQ indices may underestimate their actual degree of practice, whereas the minimal gains noted among the low education epilepsy patients may simply reflect regression to the mean alone. These data suggest that brain integrity does not solely account for differential practice effects, but that the confluence of multiple demographic and neuropsychological variables should be considered when evaluating change scores. Finally, these results underscore

the necessity of referencing test-retest performance to an appropriate control group.
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M. De LUNA, C. SANDOVAL, K. LIOW, T. DUNN, P. FEUILLAN, S. ARROYO, & W. THEODORE.The Effect of Gelastic (Laughing) Seizures on the Neuroendocrine System.
Objective: To investigate ictal and interictal neuroendocrine function in 13 patients with hypothalamic hamartoma and uncontrolled gelastic seizures (HHUGS). *Background:* Gelastic seizures are involuntary, nonmirthful laughter often associated with hypothalamic hamartomas (HH). The syndrome, HHUGS, may be accompanied by precocious puberty (PP), behavioral disturbances, and cognitive deterioration. Endocrine function is known to be affected by epileptic activity. However, the neuroendocrine system in patients with HHUGS with a lesion proximal to the pituitary has never been studied in detail. We are investigating the ictal and interictal hormone changes in these patients. *Methods:* Blood samples were obtained in 13 patients with HHUGS. All had HH confirmed by MRI; 6 had PP. Each patient had 2 blood draws: (1) baseline, fasting conditions in the AM, seizure free for 24 hrs and (2) ictal, within 5 minutes of seizure onset while on video-EEG. Hormonal levels for prolactin, sex hormone binding globulin (SHBG), insulin-like growth factor (IGF-1), TSH, testosterone, estradiol, growth hormone, and catacholamines were obtained. Differences between baseline and ictal values were analyzed using a Student's *t* test, significance set at .05. *Results:* Ictal prolactin levels failed to rise ($p = .69$). However, in patients with PP, there was a significant decrease in SHBG ($p = .016$) and IGF-1 ($p = .026$). Ictal changes for other hormones were not significant ($p > .05$). *Conclusion:* Unlike generalized tonic-clonic seizures and complex partial seizures, serum prolactin levels did not rise in patients with HHUGS. There is a decrease in SHBG and IGF-1 during seizure. Further investigation is needed to determine clinical significance of these findings.
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W.S. HOUSTON, B.K. SCHEFFT, P.K. SHEAR, & K. DeS. HAMSHER. Presidents Test Performance of Patients With Focal Epilepsy.
Retrograde memory (RM) functioning has been well-studied in patients following temporal lobectomies; however, relatively few studies have focused on presurgical epilepsy patients (Viskontas, McAndrews, & Moscovitch, 2000). We examined RM in 98 presurgical focal epilepsy patients [43 left and 40 right temporal lobe (TL) onset, and 15 frontal lobe (FL) onset] to identify factors potentially related to RM, such as the presence of damage to mesial temporal lobe structures, dissociation in RM, and the relationship between RM and anterograde memory (AM). Thus, this study was utilized as a model to examine the neurobehavioral consequences of chronic dysfunction to specific brain regions. Seizure focus was confirmed by at least 2 localizing techniques including long-term EEG/video monitoring, neuroimaging, electrocorticography, subdural strip or depth electrode recordings, and/or sodium amytal testing. Patients were administered the Presidents Test (Hamsher, 1982), a measure of memory for the current and past 5 U.S. Presidents (consisting of 4 subtests), measures of AM (Denman story recall tests, and the Recognition Memory Test for faces), naming, and intellectual functioning. Primary analyses demonstrated evidence of mild impairment in both TL and FL patients; however, the Presidents Test did not show statistical differences based on localization or lateralization of seizure focus. Other results suggest that different components of retrograde memory (e.g., declarative *vs.* semantic memory systems) may interact with lesion location to influence the finding of impairments. Finally, this study supports the notion that mesial temporal structures may not be critical for retrieval of RM.
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E.M.S. SHERMAN, D.J. SLICK, M.B. CONNOLLY, & K. EYRL. Measuring Post-Surgical Change After Pediatric Epilepsy Surgery: Use of Regression Based Change Scores.
Accurate measurement of treatment related change must account for non-treatment effects associated with outcome such as baseline functional level, practice effects, test reliability, and specific demographic variables. Regression models of change after epilepsy surgery in adults simultaneously account for these confounds and provide a standardized method for evaluating change in epilepsy surgery candidates. Unfortunately, this technique has not yet been used in children with epilepsy despite the increasing availability of epilepsy surgery in pediatric centers and the concomitant need to measure outcome. The goal of this study was to demonstrate the use of regression-based change scores in a pediatric sample using the WISC–III. Data from 52 children with intractable seizures assessed twice over 2 years were used to construct the control regression equation. Several variables were evaluated as predictors of retest IQ, including baseline score, testing interval, demographics, and measures of intractability (current and previous AEDs, seizure severity). As in the adult literature, baseline scores emerged as the strongest predictor of retest scores. Number of current AEDs and sex, though moderately correlated to retest scores, did not emerge as significant predictors in the regression equation. Change scores for a small sample of surgical candidates ($N = 12$) were then derived using the control equation in order to evaluate post-surgical improvements and declines. Using a cutoff of 1.5 *z*-score, 2 children had post-surgical improvements in IQ; no meaningful declines were observed. These results demonstrate the usefulness and adaptability of the regression-based method in evaluating treatment-related change in pediatric populations.
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S.P. BROWN, S.J. SWANSON, D.S. SABEVITZ, T.A. HAMMEKE, G.L. MORRIS, & W.M. MUELLER. Assessing Language Outcome After Temporal Lobectomy Using Regression-Based Change Norms.
Recent studies have used sensitive empirical methods such as reliable change indices and regression-based norms to detect meaningful neuropsychological change after temporal lobectomy (TL). In the present study, previously published regression-based change norms were used to assess language outcome after tailored TL. Seventy-five nonretarded, left hemisphere dominant patients with intractable epilepsy underwent either left ($n = 34$) or right ($n = 41$) TL. Group comparisons of pre- to 6-month postoperative performance on confrontation naming and verbal fluency revealed a significant difference in the Boston Naming Test (BNT) change scores ($p < .0001$) between left and right TL groups. No between group differences were found for Controlled Oral Word Association Test (COWA) change scores. Using a regression-based prediction equation, 19 of 34 (56%) left TL patients showed significant naming declines. Change scores that resulted in significant *T*-score declines ranged from −1 to −38 indicating that some of the declines were not clinically significant. Clinically meaningful decline occurred in 35% of left TL patients. Two of 41 (5%) right TL patients showed a significant decline in naming. No left and 4 of 41 (10%) right TL patients showed naming improvement. On the COWA, 3 of 34 (8.8%) left and 1 of 40 (2.5%) right TL patients showed a significant fluency decline. Three of 34 (8.8%) left and 4 of 40 (10%) right TL patients showed significant improvements in fluency. Postoperative decline in naming abilities after TL was specifically associated with a later age of onset of epilepsy. Regression-based change norms are a sensitive method for detecting language change after TL.
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D.S. SABSEVITZ, I.M. RUFF, S.J. SWANSON, G.L. MORRIS, & W.M. MUELLER. Predictors of Changes in Quality of Life Following Surgical Treatment for Epilepsy.
Studies have shown that epilepsy patients report a poorer quality of life (QOL) than the general population. However, fewer reports have exam-

ined changes in QOL following epilepsy surgery. The current study examines changes in QOL in a group of 78 postsurgical epilepsy patients who underwent comprehensive neuropsychological testing both pre- and 6 months postoperatively. Change scores (post–pre) were computed for neuropsychological measures and the different Quality of Life in Epilepsy (QOLIE-31) scales. Results showed that a reduction in seizure frequency following surgery was related to better overall QOL ($r = .38$, $p < .01$), Social Functioning ($r = .37$, $p < .01$) and to less Seizure Worry ($r = .27$, $p < .05$) and Fatigue ($r = .31$, $p < .01$) on the QOLIE-31. Postoperative verbal memory declines was associated with a poorer overall QOL ($r = .24$, $p < .05$) and self-reports of Cognitive Functioning on the QOLIE-31 ($r = .32$, $p < .01$). Naming deficits were also related to poorer reports of Cognitive Functioning ($r = .23$, $p < .05$). Additionally, postoperative increases in depressive symptomology were related to poorer overall QOL ($r = .24$, $p < .05$). Regression analyses indicated that changes in depressive symptomology were most strongly associated with changes in overall QOL ($R^2 = .13$); however, seizure and memory outcome (R^2 change = .07, .06, respectively) made significant independent contributions to predicting overall QOL. In summary, our data suggest that a combination of seizure, cognitive, and emotional factors contribute to QOL outcome following epilepsy surgery.

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W. BARR, G. NEY, & N. SCHAUL. Receiver Operating Characteristic (ROC) Curve Analysis of Verbal Test Performance in Epilepsy Surgery Candidates.

Neuropsychological testing continues to provide valuable information for determining candidacy for epilepsy surgery. Traditional statistical methods provide little information about clinical sensitivity or the ability to make accurate diagnostic classifications. The goal of this study was to determine the relative sensitivities and specificities of several neuropsychological measures of verbal skills for differentiating between epilepsy surgery candidates with left or right temporal lobe seizure foci. We computed receiver operating characteristic (ROC) curves on test scores obtained from a sample of 99 patients with unilateral temporal lobe seizure foci, diagnosed through video-EEG monitoring of ictal and interictal activity (51 LTL, 48 RTL). Test measures included WAIS–R Verbal IQ and scores from the Controlled Word Association Test, Animal Naming Test, Boston Naming Test, WMS–R Logical Memory subtest (I & II), and the California Verbal Learning Test (CVLT, Total Learning & Long Delay Free Recall). Results of traditional comparisons of group means were significant only for the Boston Naming Test [$t(df = 97) = 2.47$, $p < .02$]. ROC analysis included plotting of curves and computation of area under curve (AUC) statistics. Areas were largest for the Boston Naming Test (AUC = .649) followed by CVLT total learning (AUC = .576) and Verbal IQ (AUC = .573). The results of this study indicate that, among commonly used measures of verbal functioning, scores from the Boston Naming Test, followed by measures of learning and IQ, provide the most accurate classification of verbal test performance in patients with left and right temporal lobe seizure foci.

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M.L. SMITH, D. KADIS, M. STOLLSTORFF, L. LACH, & I. ELLIOTT. Predictors of Everyday Memory in Children with Epilepsy.

Children with epilepsy are at risk for experiencing memory deficits which have been documented with objective measures of learning and memory. The impact of these memory deficits on everyday functioning is not well understood. In adults with epilepsy, self-ratings of everyday memory are more strongly associated with emotional functioning than with performance on memory tests. In this study, we investigated the predictors of everyday memory in children, using a parent report measure to establish the impact of memory deficits on the child's daily activities. Participants included 36 children and adolescents (17 male, 19 female; *M* age 14.3, range 9–18) with intractable epilepsy who completed a battery of objective tests assessing intelligence, visual and verbal memory, and sustained attention. Parents completed a questionnaire of their children's ability to remember information and events in the context of their daily routines. The attention and anxiety/depression subscales of the Child Behavior Checklist were used as measures of everyday attention and emotional status. Stepwise regression showed that parent report of attention and a measure of verbal memory together accounted for 39.5% of the variance in everyday memory scores, the largest proportion being accounted for by the attention scale (32.9%). Measure of IQ, visual sustained attention, visual memory, and anxiety/depression did not contribute to the predictive model. These results showed that everyday memory functioning in children differs from that of adults. Complaints of memory disorders are likely to reflect difficulties in attention and/or memory and do not appear to be secondary to emotional distress, as is found in adults.

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S.L. REMINGER, A.W. KASZNIAK, D.M. LABINER, B.T. DAVID, L.D. LITTRELL, & K.L. KAEMINGK. The Impact of Seizure Foci on the Subjective Experience of Emotion in Temporal Lobe Epilepsy.

This study was designed to investigate the impact of recurrent seizures on the emotional subjective experience of individuals with epilepsy of temporal lobe origin. Nineteen individuals with complex partial epilepsy were asked to rate their subjective experience of emotion when viewing pictures and listening to sounds designed to elicit emotional responses (International Affective Picture System and International Affective Digitized Sounds). Pictures and sounds were divided into positive, neutral, and negative categories. Participants made subjective ratings on a 9-point scale of experienced valence (positive to negative) and arousal (excited to calm) in response to the stimuli. These ratings were compared to analogous ratings made by 21 normal control subjects. Patients and controls did not differ in their reported emotional experience. Both groups reported similar expected patterns of emotional valence and arousal in response to the stimuli. The patient group was separated into 2 groups based on presumed hemisphere of seizure origin (right temporal *vs.* left temporal). Although seizure lateralization had no impact on arousal ratings, a main effect was found for the valence ratings of emotional pictures. Patients with a left seizure focus reported experiencing overall greater degrees of positive emotion than patients with a right seizure focus when viewing emotionally-laden pictures. This finding is discussed in relation to hypotheses concerning hemispheric asymmetry and emotional valence.

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D.E. CRAGAR, D.T.R. BERRY, F.A. SCHMITT, T.A. FAKHOURY, C.M.S. DEARTH, & J.E. CIBULA. Psychological and Neuropsychological Differences Between Non-Epileptic Seizure Patients With and Without Neurological Histories.

Patients with epilepsy (ES) and non-epileptic seizures (NES) both show deficits on neuropsychological testing. Although the neurophysiological dysfunction experienced in epilepsy provides an explanation for these deficits in ES patients, the etiology of the neuropsychological deficits in NES patients is more obscure. One hypothesis is that psychiatric distress in NES patients underlies their neuropsychological deficits. Alternatively, Swanson et al. (2000) suggest that NES patients should be screened for positive neurological histories, as this variable might explain their neuropsychological deficits. The present study is an initial investigation into this issue and compares 3 groups of patients diagnosed with inpatient video EEG. ES patients ($n = 36$), NES patients with a history of head injury and loss of consciousness (NES+, $n = 16$) and NES patients without a history of head injury (NES−, $n = 18$) were given a neuropsychological battery as well as the MMPI–2 and the NEO–PI–R. Results showed significant group differences on the Neuroticism scale from the NEO–PI–R and clinical scales 1(Hs), 2(D), 3(Hy), 7(Pt), and O(Si) from the MMPI–2, such that the ES group had significantly lower scores whereas

the NES groups did not differ from each other. On the WMS–3 a different pattern emerged. The NES+ patients generally performed better than either the NES− group or the ES group, which did not differ. Although clearly preliminary, these results suggest that while elevated psychological distress may contribute in a complex way to neuropsychological deficits of NES patients, the role of neurological dysfunction may be less salient.

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J. BAÑOS, S. SAWRIE, C. PALMER, R. KNOWLTON, R. KUZNIECKY, & R. MARTIN. CVLT Factor Structure: Relationship to TLE Seizure Focus and Hippocampal Pathology.

The California Verbal Learning Test (CVLT) is often used in the presurgical evaluation of temporal lobe epilepsy (TLE) patients. Memory testing is often used to infer the degree of hippocampal dysfunction to assess the risk of memory deficits following surgery. Given that factor scores tend to be more stable and reliable than individual variables, the present study assessed the relationship of CVLT factor scores to seizure focus and hippocampal pathology (markers of hippocampal dysfunction). Previous factor analyses by the authors using 350 epilepsy presurgical candidates resulted in a 5-factor oblique solution with factors of: general verbal learning and recall, intrusions/recognition false positives, auditory attention, serial clustering, and perseverations. Factor scores were computed for 157 TLE surgical candidates (ages 18–64) with left ($n = 91$) or right ($n = 66$) seizure focus who subsequently underwent temporal lobe resection. Hippocampal tissue was then characterized as having mild ($n = 45$), moderate ($n = 69$), or severe ($n = 43$) pathology. Factor scores were compared in 2×3 (seizure focus $\times$ pathology) ANOVAs. Main effects of seizure focus were found for the first 3 factors (general verbal learning, intrusions/false positives, and auditory attention) but not serial clustering or perseverations. Main effects of hippocampal pathology were not found. Interactions (i.e., differential effect of left *vs.* right pathology on CVLT factor scores) were not significant, although there was a trend toward significance for the general verbal learning factor. Results suggest that while these factor scores may have clinical value in lateralizing seizure focus in TLE patients, they are less sensitive predictors of hippocampal pathology.

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N. GALVAN, J. GIRVIN, A. PARRENT, R. SAHJPAUL, & C. KUBU. Post-Operative Language Outcome Following Dominant Temporal Lobectomy.

Epilepsy patients who undergo dominant temporal lobectomy show post-operative declines in visual confrontation naming. Other aspects of language have been largely excluded from post-surgical assessments of language. The present study investigated changes in confrontation naming, phonemic word fluency, repetition, and aural comprehension in 18 epilepsy patients following dominant temporal lobectomy within the first one to two months following surgery. The roles of potential moderating variables including age of seizure onset, extent of resection, and gender were also examined. Group analyses revealed declines on measures of confrontation naming and repetition following surgery. The data were also analyzed at the individual patient level using Reliable Change Index scores. These analyses indicated that from 41–54% of all patients showed a reliably meaningful decline on confrontation naming tests. Less than 20% of patients showed reliably meaningful declines on the other measures. No significant moderating variables were found although there was a trend ($p = .67$) toward increased risk of post-operative naming declines in male patients. These data can be used to better inform epilepsy patients about the potential risks to language function following dominant temporal lobectomy.

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C.S. KUBU, A.G. PARRENT, S. WIEBE, & R.S. McLACHLAN. Bilateral Mesial Temporal Lobe Surgery and Memory Outcome.

We describe the neuropsychological and seizure outcome of a patient with intractable left mesial temporal lobe seizures who underwent a previous right temporal lobectomy. After much deliberation, the patient underwent implantation of a chronic stimulating quadripolar depth electrode along the axis of the left hippocampus attached to an implanted pulse generator. Seizure and neuropsychological outcomes were assessed using a randomized double blind control trial in which the surgeon manipulated stimulator status (off *vs.* on) over 3 2-month blocked trials. The patient was assessed by the neurologist and the neuropsychologist, who were blind to stimulator status, at monthly intervals. The patient's memory prior to surgery was significantly impaired for both verbal and visual material, yet she was still living independently. There were no effects of electrode placement or stimulator status on the neuropsychological measures or the patient's responses to a memory questionnaire. Most importantly, the patient continues to function at home as she did before surgery. The patient stopped having seizures approximately 4 months following electrode placement regardless of stimulator status (i.e., on *vs.* off). The implications of these observations for other patients with bilateral temporal lobe epilepsy in the context of the functional reserve hypothesis for memory will be discussed.

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S. CAÑIZARES, T. BOGET, E. ELICES, S. ARROYO, J. RUMIA, & M. SALAMERO. Delayed Memory Distinguishes Between Temporal and Extratemporal Lobe Epilepsy.

Objective: To compare memory performance of patients with epilepsy whose seizure foci had been well established (extratemporal or temporal). *Method:* Subjects: The sample consisted of 127 consecutive patients with drug-resistant partial epilepsy (temporal foci, TLE = 90; extratemporal foci, ETLE = 37) who were submitted to an epilepsy unit to assess their suitability for epilepsy surgery. They all underwent prolonged video-EEG monitoring, MRI, SPECT, and neuropsychological assessments. Patients were grouped according to site (temporal, extratemporal) and side (left, right, bilateral) of epileptogenic foci determined by ictal EEG. Procedure: The preoperative neuropsychological assessment included the full administration of the Wechsler Memory Scale–Revised (WMS–R). Statistical Analysis: A MANOVA was performed to analyze the effect of site and side of the epileptogenic foci on memory indexes, and also the interaction between then. A *post-hoc* MANOVA was also performed with the delayed subtests of the WMS–R as dependent variables. *Results:* The only statistically significant effect was site of foci on the delayed recall index. Patients with TLE performed worse than ETLE patients. When considering delayed subtests of the WMS–R the only statistically significant effect was site of epileptogenic foci for the verbal paired associates and visual reproduction subtests. Neither side of epileptogenic region nor their interaction with site reached statistical significance. *Conclusions:* Patients with TLE show greater delayed memory difficulties as a group than patients with ETLE, showing a comparable execution in attention and immediate memory. Theoretical implications of human models of memory are discussed.

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G.P. LEE, K. J. MEADOR, D.W. LORING, J. ARENA, S.B. PETERS, & G.S. CASARES. Does Mesial Temporal Lobe Dysfunction Interfere With the EMG Biofeedback Response?

The biofeedback relaxation response is thought to be mediated by the autonomic nervous system (ANS). Because the amygdala and related pathways in the mesial temporal lobes of the brain regulate the ANS, the

question arises whether damage to the mesial temporal lobes would interfere with biofeedback training. To examine this possibility, we evaluated EMG biofeedback in 12 inpatients with temporal lobe epilepsy by placing 2 surface recording electodes on the frontalis muscle above the eyes and providing auditory feedback *via* tonal pitch. Mean age of the patients was 36.08 years, and mean duration of seizure disorder was 16.50 years. There were 7 males and 5 females. A single session lasting approximately 50 min was conducted which included: (1) 5-min adaptation period with eyes closed, (2) 5-min baseline, (3) 4-min self-control phase, in which patients attempted to decrease their forehead muscle tension without feedback, (4) feedback training lasting 20 min, and (5) 4-min post-feedback self-control phase. Patients were offered suggestions to help potentiate the relaxation response and asked to assume a passive attitude by "letting the response happen" rather than "trying to make it happen." There were statistically significant reductions in frontalis muscle tension from baseline to the post-feedback self-control phase ($p = .02$) and from the pre-feedback to post-feedback self-control phases ($p = .03$). Results suggest that patients with subtle unilateral mesial temporal lobe dysfunction (i.e., epilepsy) retain the capacity to benefit from EMG biofeedback training.

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B. OERBECK, S. HEYERDAHL, I. REINVANG, K. SUNDET, & H. TORGERSEN. Cognitive ERPs in Early Treated Young Adults With Congenital Hypothyroidism.

Thyroid hormones are involved in normal synaptogenesis and myelination of the central nervous system. In congenital hypothyroidism (CH), despite early treatment, some children develop neurological and intellectual deficits. Event-related potentials, cognitive and behavioral functioning were assessed in 12 young adults (*M* age 20 years) with early treated severe congenital hypothyroidism (*M* serum T4 at diagnosis 20 nmol/L, *M* age at start of treatment 18 days). A group of 12 siblings (*M* age 22 years) acted as controls. Mean total IQ (WASI) was 100 ($SD = 12$) in the CH group, 109 ($SD = 12$) in the sibling group ($p = .225$; ns). ERPs were recorded to auditory standard and target events in an oddball paradigm. Subjects responded with button press to stimulus categories defined by pitch differences. Behavioral results showed no group differences in accuracy or reaction time. Group differences were found in early ERP components tapping sensory processing and selective attention triggering. Latency of the P1, N1, and P2 components were significantly delayed in patients compared to controls. Amplitude differences were significant for N1 with lower amplitudes in the study group. No group effects were found on the P3 component, suggesting normal allocation of cognitive resources to the task. The results were analyzed in relation to thyroid deficiency at diagnosis (prenatal effect), early treatment (postnatal effect), and hormone level at the time of assessment. Significant relations to early ERP components were found for initial thyroid deficiency level, while early treatment level correlated to later ERP components. Actual hormone level did not influence ERP components.

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T. JAMES, J. DYWAN, & S. J. SEGALOWITZ. ERPs to Emotional Words in a Study on Source Monitoring and Aging.

Source memory judgments can be influenced by many factors, including stimulus emotionality. For example, emotional words have been shown to produce both a feeling of remembering and an enhanced event-related potential (ERP) response in young adults. We sought to further investigate this influence of emotionality in older adults. While older adults ought to make more source memory errors in response to familiar or distracting information (such as emotional words), recent research also shows that older adults are less responsive to emotional information than are younger adults, perhaps because of improved emotional control. We predicted that older adults would be less influenced by emotionality than younger adults when making source memory decisions. To test this, we presented younger and older adults a list with emotional and neutral words to study. These words were subsequently interspersed among a series of new emotional and neutral lures; participants discriminated previously studied from new lures by computer key press, while we recorded ERPs. Behavioral results indicated that both study and lure emotional words were more than twice as likely to be designated "old" as neutral words. Unexpectedly, this effect did not interact with group. Of even greater interest however, was a lack of effect for emotionality within the ERP data of both groups.

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M. J. COONS, T.I. MURPHY, & S. J. SEGALOWITZ. The Effect of Sleepiness on Attentional Control: An ERP Study.

The contingent negative variation (CNV) event-related potential is known to be attenuated by sleepiness, but also by inattention. Whether these are independent effects is not known, i.e., sleepiness can bring on inattention. Attention can be increased reactively (by increasing the salience of the stimulus) or endogenously (through incentives to perform). We examined the effect of physiological arousal on these attention mechanisms (a) by collecting CNVs very late at night and in the morning after a full night's rest, (b) by manipulating stimulus salience in a Go/No Go paradigm (Go stimuli are more task salient), and (c) by altering incentives by a monetary payoff for good performance. Twelve women (19–45 years) participated in 2 sessions (11:00 a.m. and 3:30 a.m., counter-balanced across subjects), performing a Go/No Go CNV task twice, the second time with a payoff for fast accurate responses. *Results:* (1) CNV amplitudes on Go trials were much larger than on No Go trials (-3.34 *vs.* $-.16$ μV; $p < .001$), with this effect almost double in the Pay *versus* the No Pay condition ($p = .02$), but with reduction due to sleepiness. (2) The interaction between arousal and incentive (Pay/No Pay) was significant ($p < .05$) especially in the Go trials ($p < .02$): Subjects produced larger CNVs in the Pay condition while alert, but not while sleepy. We conclude that sleepiness reduces one's ability to maintain sustained attention endogenously motivated (payment manipulation), while not reducing the same cortical response when reactively motivated (with Go *vs.* No Go stimuli).

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M.I. BOULOS, W.R. STAINES, A.A. ASHAMALLA, & K.K. ZAKZANIS. Investigation of the EEG During Word Recognition for an Amnesic Subject.

Recent functional neuroimaging studies have suggested that the left prefrontal cortex is preferentially involved in the encoding of episodic memory in healthy individuals while the right prefrontal cortex is preferentially involved in the retrieval of episodic memory. Few studies have further investigated the physiology of the encoding/retrieval system in patients with amnesia using word recognition tasks. In the present study, right prefrontal neural activity associated with word recognition memory was investigated using electroencephalogram (EEG) in a patient with amnesia (FP). FP was administered the Rey Auditory Verbal Learning Test and was tested with a recognition trial 20 min later. During the recognition trial, reaction time (RT), EEG, and the subject's responses were recorded. EEG was measured from Fp2 (right prefrontal zone). Our results indicate that incorrectly classified old words elicited neural activity in the 500 ms time window. This effect provides electrophysiological evidence that a specific event occurs in the brain in response to the presentation of studied words, whether or not those words are consciously remembered.

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Poster Session 6/3:00–5:30 p.m.

fMRI AND IMAGING

G.R. TURNER, S. J. HEVENOR, S.I. GRAHAM, C.L. GRADY, & B. LEVINE. The Functional Neuroanatomy of Delayed Response Tasks as Revealed by fMRI.

The role of the prefrontal cortex (PFC) in mediating performance on 3 classic delay tasks: spatial delayed response, delayed alternation, and object alternation, has been investigated with focal lesion studies in monkeys (Mishkin, 1964) and humans. Functional magnetic resonance imaging (fMRI) techniques were used to investigate the functional neuroanatomy of these tasks in healthy adults. Participants ($N = 10$; 5 males; M age = 24) were scanned in a 1.5 T scanner while performing the 3 tasks (and an object-based delayed response task). Trials for each task were blocked and alternated with trials of a perceptuomotor control task in a standard boxcar design. Significant activations were recorded in the PFC across all 4 tasks. Maximal activity was observed in regions of dorsolateral prefrontal cortex in the vicinity of the superior and middle frontal gyri (Brodmann areas 8, 9, 10, and 46). Patterns of dorsolateral PFC activity were consistent for both the spatial and object versions of the delayed response tasks; a result not predicted by either the mnemonic domain or processing theories of functional specialization for working memory within the PFC. A recently proposed model dissociating memory selection from maintenance processes within the dorsolateral PFC was partially supported. Significant activations were recorded in the anterior cingulate during object alternation performance. This result is consistent with human neuropsychological reports and previous functional neuroimaging studies implicating this region in response inhibition and cognitive control processes.

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P. KOENIG, E. SMITH, C. DEVITA, P. MOORE, C. MCMILLAN, & M. GROSSMAN. Cortical Activity During Similarity- and Definition-Based Categorization.

We compared cortical activation during category membership judgments following training with similarity- or definition-based processes, using BOLD fMRI at 4T. Stimuli were 64 pictures of biologically plausible novel animals representing all combinations of 6 binary features (e.g., snub/pointy snout). Category members contained at least 3 of the designated prototype's 4 most salient features, which were empirically determined beforehand. Training in the Similarity condition ($n = 6$) required judging which of paired member and nonmember animals most resembled the accompanying prototype. The Definition condition ($n = 6$) required judging which animal in the same pairs contained 3 of the 4 salient features, based on accompanying descriptions and outlines. Testing for both conditions involved judging category membership of all items. We analyzed correct responses to members at test in this event-related design, using SPM 99. Both conditions recruited ($p < .05$, corrected) left inferior parietal (BA39/40) and right inferior frontal regions (BA44), supporting feature integration and retrieval. The Rule condition additionally recruited right lateral parietal-occipital (BA19), supporting feature configuration, left premotor/inferior frontal (BA6/44), for verbal working memory, and bilateral anterior cingulate (BA24/32) and left thalamus regions, supporting selective attention and competition monitoring. Direct contrasts ($p < .001$, uncorrected) associated the Similarity condition with left parietal-occipital, left posterolateral temporal, and right polar-frontal areas, and the Definition condition with bilateral parietal-occipital, bilateral inferior frontal, bilateral anterior cingulate, and left inferior parietal areas. These findings suggest that distinct categorization processes involve partially overlapping and partially distinct neural substrates.

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F. HILLARY, N.A. CHIARAVALLOTI, J. DELUCA, J. RICKER, W. LIU, & A. KALNIN. Cerebral Activation During Rehearsal in Multiple Sclerosis Using fMRI.

This pilot study examined patterns of cerebral activation in individuals diagnosed with multiple sclerosis (MS) and healthy adults during a working memory task. BOLD functional magnetic resonance imaging (fMRI) was performed on a 1.5 Tesla GE scanner to assess cortical activation in individuals performing a working memory task based on the Sternberg paradigm (Sternberg, 1969). Participants included 5 individuals diagnosed with MS and 4 healthy controls. Healthy controls were matched with the MS sample for age, education, and estimated premorbid IQ. FMRI data were analyzed using Statistical Parametric Mapping (SPM99) software, with a stringent significance level (alpha $< .005$, voxel extent ≥ 8). Task difficulty was manipulated through increasing the number of letters to be encoded, and through increasing the length of time that strings of letters were to be rehearsed. Initial analyses revealed that rehearsal in controls was typically isolated hemispherically, and was predominantly fronto-temporal in nature (3 of 4 participants). Activation during both analyses in individuals with MS revealed greater bilateral activation that extended from the fronto-temporal areas to parietal areas (5 of 5 participants). Pre-scanning neuropsychological testing determined that 3 of the MS subjects demonstrated working memory impairment. Of note is that these 3 individuals demonstrated the greatest extent of bilateral activation. Such greater bilateral activation among individuals with MS who have compromised working memory may indicate the need for recruitment of additional cerebral resources, which has implications for task difficulty and degree of cognitive deficit in MS.

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A. GLEASON & C. MEYERS. Relationship Between Cognitive Impairment and Tumor Grade in Presurgical Patients With Primary Brain Tumors.

Although tumor grade (or the degree of anaplasia or cell death) is highly predictive of length of survival time, little is known about the relationship between tumor grade and cognitive impairment. Research that has been conducted (De Winter et al., 1997) evaluated post-surgical patients diagnosed with glioblastoma multiforme (GBM) and anaplastic astrocytoma (AA), the 2 highest grades of tumor. The present study evaluated patients presurgically and included all tumor grades. The degree of cognitive impairment was assessed in 94 presurgical patients with primary gliomas (37 diagnosed with low-grade gliomas, 29 with anaplastic gliomas, and 28 with glioblastoma multiforme). A profile analysis revealed that patients with more aggressive, faster-growing tumors (GBM or AA) displayed more severe cognitive impairment at their presurgical evaluation than patients with more slowly growing tumors (low grade gliomas). Significant differences were demonstrated between the performance of patients with AA and low-grade tumors on the following neuropsychological tests: Digits Forward, Similarities, and Block Design from the WAIS–R; Trail Making Test A & B; and Grooved Pegboard with the right hand. Also, significant differences were found between the performance of patients with GBM and low-grade tumors on these measures: Digits Forward, Digits Backward, Block Design, and Digit Symbot from the WAIS–R; Trail Making Test A & B; and Grooved Pegboard with the right hand. The average performance of patients with AA and GBM tumors significantly differed only on digits backward. The present study helps to clarify the relationship between the degree of cognitive impairment and tumor grade, by precluding the confounding effects of surgery and treatment on cognitive status.

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A.B. MOORE, C.E. WIERENGA, K.K. PECK, B. CROSSON, K. GOPINATH, N. HIMES, D. SOLTYSIK, L. MAHER, L. J. GONZALEZ-ROTHI, & R.W. BRIGGS. Role of Baseline Tasks in Understanding Syntactic Production with FMRI.

We hypothesized that, in FMRI, object naming would provide a better baseline state than nonsense object viewing to isolate syntactic processing

during sentence generation. During FMRI (2-spiral gradient echo acquisition), 6 right-handed participants (ages 41–58) silently generated sentences describing events depicted in simple line drawings. Hemodynamic responses for sentence generation were deconvolved from the signal response to stimuli compared to a baseline state. For 3 runs, the baseline state was passive viewing of nonsense objects; for 3 runs, the baseline state was object naming. Area under the hemodynamic response curve was calculated for each subject and analyzed in *t*-tests ($p = .001$). Results of sentence generation *versus* nonsense object viewing revealed activity in Broca's area, though not as robust as that of some other regions. The left anterior superior temporal gyrus and the angular gyrus showed more robust activation, as did the right cerebellum. Results of sentence generation *versus* naming revealed less robust activity overall with major areas of activation evident in the right posterior cingulate, left hemisphere occipitotemporal junction, and the right hemisphere superior parietal regions. Broca's area did not show robust activation in this condition. Given the importance of Broca's area in agrammatic aphasia and the appearance of activation in Broca's area during syntactic comprehension, the minimal activation of Broca's area in the object naming condition was unexpected. Findings suggest that nonsense object viewing is the more appropriate control task for FMRI of sentence production, although it was not expected to be as selective as object naming in isolating syntactic processing; finally, selection of a control task in FMRI is pivotal to understanding the pattern of neural activity.

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A. CHAN, W. HE, Y. CHAN, D. YEUNG, M. CHEUNG, J. LAM, & M. CHUNG. Prefrontal Involvement for Memory Retrieval: Bilateral Better Than Unilateral.

While the majority of PET studies suggested that retrieval of newly learned information is primarily mediated by the right prefrontal cortex (UL), some studies reported bilateral prefrontal cortex involvement (BL, Nyberg et al., 1996). These inconsistent findings may suggest that different individuals utilize various neurocognitive processing to mediate retrieval; however, little is known about the effectiveness of these two processing types. That is, whether the involvement of two lobes is better than one lobe? The present study aimed at examining the prefrontal involvement and the effectiveness of different neuro-network processing for retrieval. Six healthy (3 male & 3 female) volunteers (mean age = 24, education = 13) participated in the study. A 1.5 T MRI system with EPI sequence TR/TE/θ 2000/40/90° was employed for functional imaging, and a blocked-designed paradigm with 3 task-rest cycles was used. Subjects were instructed to judge whether a presented word was included in a previously learned word list. MEDx V.3.3 was used for data analysis with the activation map generated at a threshold of $p < .05$. Results suggested that half of the subjects showed UL activation and the other half showed BL activation. There was no difference in terms of age ($t = -0.588$) and education level ($t = -1.00$) between these two groups. However, the BL group could recognize more words (mean = 8.33 words; $SD = 1.15$) than the UL group (mean = 6.67; $SD = 2.08$). These results showed that individuals who demonstrated bilateral prefrontal involvement for memory retrieval seem to have better performance than those who showed unilateral prefrontal activation.

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R.M. LAZAR, B.-F. FITZSIMMONS, M.F. BERMAN, & R.S. MARSHALL. Systematic Reinduction of Former Stroke Deficits with Intravenous Midazolam.

Anecdotal reports have suggested anesthesia-induced transient unmasking of focal neurobehavioral deficits. We sought to deliberately unmask former deficits in patients recovered from stroke. Eight patients with image-verified stroke were studied, 5 who had recovered from left cerebral lesions and 3 from right cerebral events. Strokes occurred from 9 days to 6 years earlier. While monitored for vital signs, each patient underwent baseline testing for motor function in each upper extremity, aphasia (left hemisphere function), and left hemispatial neglect (right hemisphere function). Then, IV midazolam was delivered at 0.5 ml increments until mild drowsiness was detected. Patients were then administered similar versions of the entire battery. After 2 hrs when sedation had dissipated, the battery was readministered. Videotape was used for blinded data collection. Statistical analysis was performed with χ^2 and linear regression. Following the administration of midazolam (1.5 to 5 mg), patients with left hemisphere stroke demonstrated re-emergence or worsening of right hemiparesis and aphasia but no left neglect. In contrast, patients recovered from right cerebral stroke showed left hemiparesis and left visual-field neglect but no aphasia. All patients returned to baseline after 2 hrs. Under conditions of light sedation, patients who had recovered from stroke showed transient re-emergence of focal neurological deficits corresponding to their initial stroke presentation. Additional research is needed to determine whether this effect was the specific result of the GABA-agonist properties of midazolam.

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J. ANDERSON, V. SRIKANTH, M. SALING, A. THRIFT, H. DEWEY, & G. DONNAN. Cognitive Outcome After Lacunar Infarction: Clinical *versus* Experimental Findings.

Researchers have traditionally argued that individuals demonstrate no cognitive change following lacunar infarction. Nevertheless, patients who have suffered a lacunar infarct often complain of subtle cognitive difficulties post-stroke. Investigation in this area has typically been based on clinically oriented tests of cognition, which are usually limited in their ability to identify subtle high level changes in cognitive functioning. Recently, it has been suggested that lacunar infarction patients may experience high level "mental capacity" difficulties, which are not assessed with traditional clinical neuropsychological tools. A community-based population of 30 first-ever lacunar infarction patients 3 months post-stroke as well as 30 matched controls were recruited through the North Eastern Melbourne Stroke Incidence Study (NEMESIS). After administering an extensive neuropsychological battery containing clinical assessment tools, a computer-based experimental paradigm was developed and administered to investigate rate of information gain and limitations in mental capacity. As expected, 3 months post-stroke, stroke, and matched control subjects demonstrated no significant differences on clinical measures of general neuropsychological functioning. Performance differences between lacunar infarction and control subjects will be discussed for the mental capacity and rate of information gain paradigms.

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E. SVOBODA, C.A. HYNES, A.F. CAMPBELL, L.A. DADE, M. MOSCOVITCH, & B. LEVINE. The Frontal Lobes and Autobiographical Memory: Differential Effects of Dorsolateral and Ventrolateral Prefrontal Damage.

Lesion and functional neuroimaging research implicates the frontal lobes in a variety of memory tasks, especially those involving higher level executive demands. Very few studies, however, have investigated the effects of frontal lobe brain damage on autobiographical memory. In the present study, patients with frontal damage were administered a test of autobiographical memory that had been previously validated in healthy younger and older adults. The protocols were transcribed and scored according to a highly reliable procedure that dissociates episodic re-experiencing (i.e., contextual details pertaining to the unfolding of the story, perceptions, time, place, thoughts, and feelings) from nonepisodic aspects of autobiographical memory retrieval (i.e., semantic details not reflective of re-experiencing or details external to the defined event). Following from cytoarchitectonic and functional evidence of intrafrontal dissociations, patients with dorsolateral prefrontal cortical (DLPFC) damage and ven-

trolateral prefrontal cortical (VLPFC) damage were investigated separately. Relative to controls, the protocols of patients with VLPFC damage reflected reduced episodic re-experiencing and contained increased non-episodic details. In contrast, DLPFC patients produced extremely lengthy, rambling protocols, with significantly more details of all types in comparison to controls. Following a structured interview designed to assist retrieval, the VLPFC deficit was attenuated. This interview did not reduce the verbosity of DLPFC patients. Our findings are consistent with prior research demonstrating differential contributions of the DLPFC and VLPFC to memory processes, with the former involved in retrieval monitoring and the latter involved in retrieval cue specification.

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J. McCONNELL, M. KELLY, V. INGRAM, & M. BAGGETT. Repeat Neuropsychological Evaluation Post Thalamic Stroke in 22-Year-Old Female.

Isolated thalamic infarctions are a relatively rare clinical phenomenon providing a unique opportunity to study the thalamus and its role in neurological and neuropsychological behavior. Four major syndromes corresponding to the primary arterial territories of the thalamus have been described in the literature by Bogousslavsky and colleagues (1986). The main vascular territories comprise the territory of the (1) inferolateral arteries, (2) tuberothalamic artery, (3) posterior choroidal arteries, and (4) paramedian. Of these territories, significant neuropsychological dysfunction has been demonstrated post infarction in the tuberothalamic artery and the paramedian territory; whereas neuropsychological deficits are relatively mild or absent following infarction in the posterior choroidal arteries and inferolateral arteries, respectively. Comprehensive repeat neuropsychological evaluation was performed 10-days and $8\frac{1}{2}$-months post left thalamic infarction of the paramedian territory in a 22-year-old female whose known risk factors included oral contraceptive use, cigarette smoking, headaches, and remote cocaine use 6-years previously. Initial testing revealed pronounced memory impairment, primarily in the verbal domain, but visual memory was affected as well. Additionally, deficits were demonstrated in confrontational naming, attention, and motor performance. Striking apathy and a lack of insight concerning the severity of her dysfunction were also noted. Follow-up evaluation reveals persisting impairment including memory dysfunction and personality changes. These findings are discussed, along with neuroimaging test results and presenting neurological symptoms, in relation to the clinical syndrome and long-term prognosis concerning infarction of the paramedian territory of the thalamus.

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T. ZAWACKI, L. SWEET, R. PAUL, D. MOSER, & R. COHEN. SPECT Correlates of Apathy in Patients with Vascular Dementia.

Behavioral disturbances such as apathy frequently accompany the cognitive and functional decline evidenced in dementia syndromes. Frontal and anterior temporal lobe hypoperfusion have been reported to correlate with apathy severity in Alzheimer's disease. Much less is known about the correlates of apathy and regional cerebral blood flow in vascular dementia (VaD) patients. Regional brain perfusion in 29 patients with VaD using single photon emission computed tomography (SPECT) was examined. Stepwise linear regression analysis revealed left mesial temporal hypoperfusion was significantly related to apathy. Left mesial temporal region accounted for 28% of the variance in apathy severity. We also distinguished between VaD patients with MRI identified stroke ($n = 14$) and those with subcortical hyperintensities only ($n = 15$). Separate stepwise linear regression analyses for these 2 groups both independently indicated the role of left mesial temporal region. However, different additional regions of hypoactivation were found to contribute to the relationship with apathy between these VaD groups. These findings are consistent with previous reports of the association between apathy and the mesial limbic region. The potential roles of diaschisis and subcortical ischemia in the differential regions of SPECT hypoperfusion associated with apathy are discussed.

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M. MATSUI, J. MATSUZAWA, L. NIU, T. KONISHI, K. NOGUCHI, & S. YAGI. Age-Related Volumetric Changes of Prefrontal Gray and White Matter in Healthy Infants and Children.

Despite the role of the prefrontal cortex as the neural substrate of the higher cognitive function and its importance to the development of the human brain, little is known about neuroanatomical changes in humans. In this study, we evaluated prefrontal gray and while matter volume in healthy infants, children, and adults. Magnetic resonance imaging was performed on both 28 normal children (14 boys and 14 girls) aged 1 month to 10 years and 40 healthy adults (20 men and 20 women, M age = 20.3 years). Gray and white matter volumes of the dorsolateral, dorsomedial, orbitolateral, and orbitomedial prefrontal cortex were quantified. The results indicated that children over 2 years had significantly larger prefrontal gray matter volume compared to adults. Infants had smaller dorsal, but not medial, prefrontal gray matter volume compared to children. In contrast, the volume of white matter across prefrontal subregions was lower in infants compared with both children and adults. These findings suggest developmental differences within sectors of the prefrontal lobe and evidence for neural pruning during adolescence. The study of normal brain development in neural pruning and myelination may be useful for understanding the mechanism of neurodevelopmental disorders.

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M.E. ZIMMERMAN, G.E. GETZ, M. LOPEZ-LARSON, P.K. SHEAR, S.M. STRAKOWSKI. Neurocognitive Correlates of Prefrontal Cortex Subregion Volumes in Bipolar Disorder.

There is preliminary evidence to suggest that cognitive impairment in patients with bipolar disorder (BPD) appears to be related to structural brain abnormalities. The present study examined whether MRI-derived volumes of prefrontal cortex subregions (anterior cingulate, superior, middle, inferior, and orbital) were associated with executive functioning in 10 patients with BPD and 10 healthy volunteers (HV). Wilcoxon Rank Sums tests indicated that there were no significant differences between the 2 groups in the volume of any of the PFC subregions ($z = .87$ to .04, $p = .40$ to .97). Wilcoxon Rank Sums tests indicated that patients demonstrated increased numbers of perseverative responses on the WCST ($z = -2.2$; $p = .04$) and poorer performance on the WAIS–III Letter-Number Sequencing subtest ($z = 2.3$; $p = .03$) as compared with HV. Spearman rank-order partial correlation coefficients, controlling for total cerebral volume, indicated that in the BPD group, medium to large effect sizes were present in the correlations between increased anterior cingulate volume and WAIS–III Letter-Number Sequencing ($r_s = -.69$, $p = .04$), number of perseverative responses on the WCST ($r_s = .55$, $p = .12$), and Trail Making Test Part B ($r_s = .46$, $p = .21$), which showed trends towards statistical significance. The findings of this preliminary study suggest that perfrontal cortex subregion volumes in bipolar disorder may be associated with performance on tests of executive functioning.

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P. MATTIS, D. ZGALJARDIC, A. FEIGIN, M. FUKUDA, V. DHAWAN, J.S. PAULSEN, & D. EIDELBERG. Neuropsychological Correlates of Brain Metabolism (PET) in Presymptomatic HD.

Huntington's disease (HD) is a neurodegenerative disorder that is characterized by motor, cognitive, and behavioral disturbances. Previous work using FDG/PET neuroimaging and network analysis revealed a distinct distribution of abnormal brain metabolism in presymptomatic HD patients. This HD-Related Pattern (HDRP), which discriminated HD gene

carriers from normal controls, was characterized by striatal hypometablism covarying with calcarine cortex hypermetabolism. In the present study, we sought to characterize the relationship between neuropsychological (NP) performance and brain networks in HD gene-positive individuals. Nine presymptomatic HD gene-positive subjects [CAG repeat length $\geq$ 39; age = 46.9 $\pm$ 10.8 years (*M*/*SD*); and education = 14.6 $\pm$ 1.9 years] underwent FDG/PET imaging and a comprehensive NP evaluation. We utilized a network modeling approach to identify disease-related regional metabolic covariance patterns. Stepwise multiple regression analyses were used to determine if NP performance correlated with the identified networks. Network ananlysis revealed 2 HD related brain networks. The first pattern, characterized by relative calcarine and cuneus hypometabolism covarying with pontine and medial temporal hypermetabolism (71.4% variance accounted for), was predicted by performance on the Hooper VOT, CVLT (delayed recall), and Stoop (color/word). The second pattern, previously identified as the HDRP, did not correlate with NP performance, but does appear to be related to HD clinical severity. We identified aspects of NP performance that correlate with the expression of a brain network in presymptomatic individuals carrying the HD gene. The current findings suggest that separate, perhaps overlapping, metabolic brain networks may be related to the different clinical manifestations of HD.
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A. JAK, P.K. SHEAR, M. ZIMMERMAN, G. GETZ, M. DELBELLO, & S. STRAKOWSKI. Brain Structural Correlates of Memory in Bipolar Disorder.
Previous research has demonstrated that patients with bipolar disorder (BPD) demonstrate cognitive deficits as well as brain structural abnormalities that may affect primarily subcortical and frontal regions. The aim of this study was to examine whether the memory abilities of 24 patients with BPD were correlated with MRI-derived volumes of frontal and subcortical structures (prefrontal cortex, caudate, and putamen) or, rather, with mesial temporal structureal volumes (hippocampus and amygdala). Results indicated that, in comparison to a group of 21 healthy volunteers, patients performed significantly more poorly on tests of working memory, verbal learning and recognition, and nonverbal recall ($p < .01$ for all comparisons). In terms of MRI results, patients had significantly smaller volumes than controls in the left and right prefrontal regions, left and right amygdala, and left and right hippocampus ($p < .05$) but did not differ on caudate or putamen volumes. After controlling for total intracranial volume size and age, partial correlations in the patient group indicated that larger right prefrontal volumes ($r = -.48$, $p = .03$) and larger left putamen volumes ($r = -.45$, $p = .04$) were associated with poorer learning on the CVLT. Verbal learning was found to be associated with frontal and subcortical volumes. We did not identify deficits in retention or delayed recall abilities, nor were these abilities associated with mesial-temporal volumes.
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S. BELL MCGINTY, M.A. BUTTERS, P. GREER, C. CIDIS MELTZER, C.F. REYNOLDS III, & J.T. BECKER. Brain Morphometric Abnormalities in Geriatric Depression.
Brain morphometric studies focusing on specific regions-of-interest have identified several structurally abnormal neuroanatomical regions in patients with late-life depression (LLD), including reduced volume of the hippocampus, caudate nucleus, and frontal lobe white matter. Furthermore, late-onset depression (LOD; first lifetime episode after age 60) is thought to be a prodromal dementia syndrome. The purpose of this study was to compare regional gray matter volumes in elderly patients diagnosed with depression relative to nondepressed controls using a whole brain voxel-based analysis. High-resolution anatomical MRI scans were obtained on 30 cognitively intact subjects with major depressive disorder and 47 age-matched controls. The general linear model was applied to localize brain regional differences in gray matter using a threshold of 30 contiguous voxels and $p < .01$. Depressed subjects had a significant decrease in right hippocampal volume. LOD subjects had significantly greater volume loss of the right hippocampus, bilateral insula, and bilateral middle temporal gyrus relative to early-onset (EOD) subjects. Relative to controls, LOD subjects had greater volume loss of the superior frontal gyrus, bilaterally, and the right hippocampus ($p < .001$). These data provide further evidence of structural brain abnormalities in LLD, particularly those with LOD. Our finding of greater hippocampal volume loss in LOD relative to EOD challenges the stress-induced glucocorticoid toxicity model of depression that links hippocampal damage to elevated cortisol levels, particularly among EOD subjects. Our finding suggests that both EOD and LOD patients have reduced hippocampi, perhaps due to different processes. In particular, LOD may reflect early Alzheimer's disease.
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Poster Session 6/3:00–5:30 p.m.

SEX AND LATERALITY

M. MCINTOSH & L. MELAMED. Gender Differences in the Relationship Between Executive Function and Verbal Learning.
Although data have shown gender differences on clinical verbal learning tests, the relation of gender differences on executive function measures to verbal learning performance is not yet established. The present study examines gender differences on common clinical executive measures and their ability to predict performance on a verbal learning test, the California Verbal Learning Test (CVLT). Executive measures such as: phonological fluency (FAS), categorical fluency, Ruff Figural Fluency, and Trails-B were administered to 51 female and 41 male normal college students with no history of neurological trauma. These measures were entered into a factor analysis that revealed significantly overlapping factors for both groups; however, notable differences for factor loadings occurred. Following this analysis, predictors were chosen and entered into a regression equation using .051 backward elimination criteria for predicting CVLT performance. Resulting equations accounted for 10.2%–29.5% of the variance for females and 12.5%–27.1% of the variance for males. Females' results showed: categorical fluency predicted short delay free recall, FAS total predicted short delay cued and long delay free recall, and categorical fluency and Ruff perseverations both predicted long delay cued recall. For males, categorical perseverations predicted short delay free and cued recall and long delay free recall. Categorical perseverations and FAS total predicted long delay cued recall. Overall, for males, categorical perseverations significantly predicted short and long delay recall while FAS total was a more consistent predictor of females' performance.
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M. MCINTOSH & L. MELAMED. Gender Differences on Working Memory Measures and Their Predictive Ability for Selective CVLT Measures.
Considerable research has highlighted gender differences in both working memory and verbal learning. The present study explores the roles of both gender and working memory on those measures of the California Verbal Learning Test (CVLT) most likely influenced by working memory ability (CVLT totals, perseverations, and intrusions). A common set of working memory measures from the Wechsler Memory Scale III (WMS) (letter-number sequencing, spatial span forward, and spatial span backward) and a digit recall task developed for this research, requiring participants to complete a series of 2-digit math problems while later recalling the last digit of each problem, was administered to 51 female and 41 male normal college students with no previous neurological trauma. These working memory variables were entered into factor analyses, which revealed overlapping factors; although, notable differences in factor loadings for each sex occurred. Based on the loadings, the variables were entered into a

regression equation using a stringent backward elimination procedure to predict CVLT performance. The analyses demonstrated the only working memory measure to predict CVLT total for males and females was performance on digit-recall. CVLT perseverations were predicted by digit-recall for females, but not for males. No predictors of CVLT intrusions were discovered for either group. WMS measures were not significant predictors of CVLT performance even when the potential moderating influence of the digit-recall task was removed.

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D. VOYER, A. ROYAL, & V. BOUDREAU. The Reliability of Dichotic Listening Tasks: Taped *versus* On-Computer Methodologies.

Two experiments investigated the reliability of a dichotic listening task under 2 conditions of administration: on tape or directly on a computer. In Experiment 1, 40 right-handed participants were randomly assigned to a condition in which a dichotic word recognition task was completed twice either in a taped version or directly on a computer. In Experiment 2, 20 right-handed participants completed a dichotic consonant-vowel pairs recognition task twice under both the taped condition and the on-computer condition. In both experiments, the expected right ear advantage (REA) was obtained and its magnitude was not affected by the testing procedure. However, the results showed that the taped administration produced more reliable laterality effects than the on-computer procedure. These findings suggest that the taped approach should be recommended when one wants a reliable measure of laterality. Means of improving the reliability of on-computer administration are discussed.

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L.M. BAILEY, W.F. McKEEVER, & D.A. RICH. Pregnancy, Birth Stress, and Left-Handedness: The Role of Parental Handedness.

Pregnancy and birth stress events have been postulated by Bakan (1971) and Coren (1995) as causes of left-handedness. Despite many studies of this question, results have been rather inconclusive. It seems clear that *severe* pregnancy and birth stress events are associated with somewhat elevated rates of left-handedness, but the number of such cases is small and cannot account for the roughly 10% and 12% of females and males, respectively, who are left-handed. There are a number of methodological weaknesses apparent in the literature, including quite small samples, inquiries restricted to only a few possible stressors, and inquiries of offspring themselves about the presence or absence of stressors associated with their own births (e.g., both Bakan, 1971 and Coren, 1995). Importantly, studies have failed to consider the handedness of parents. If most instances of left-handedness reflect genetic effects, one would expect left-handedness due to pregnancy/birth stress events to be most discernible in children of 2 right-handed parents. We report results of a large-scale, long-term project, with maternal reports regarding stressors. The strategy of looking particularly at offspring of right-handed parents did reveal some factors associated with left-handedness of offspring (e.g., maternal age, aspirin use during pregnancy, jaundice) that were either not seen or seen with reduced clarity when parental handedness was not considered. Still, results show the contribution of such stressors to the incidence of sinistrality to be quite small, a fact that buttresses the view that handedness is due mainly to genetic factors.

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W.F. McKEEVER, S.M. SMITH, J. JENKS, L.M. BAILEY, & S.M. WU. A "Mozart Effect" for Verbal But Not Spatial Performance.

Rauscher et al. (1993) reported that listening to 10 minutes of the Mozart Sonata for Two Pianos enhanced the spatial reasoning performance of subjects, as compared to listening to no music (silence) or to "relaxation" music. The Mozart Sonata was hypothesized to induce a neurocognitive activation that was conducive to good spatial reasoning performance. Subsequent studies have produced conflicting results. Questions regarding the influence of differing levels of activation and liking of the music experienced have been raised. In our study, 30 subjects were randomly assigned to each of 3 music exposure conditions (between subjects design). These were the Mozart Piano Sonata, the Ravel G Minor Piano Concerto, and the part of a recording by the Big Hunk O' Cheese alternative music group. Subjects took the Stafford Identical Blocks Test and the Shipley-Hartford Vocabulary Test (a multiple choice vocabulary test), in that order, following the music without experimenter interruption. Results showed no difference in spatial test performances of the groups, but the Mozart group did perform significantly better than the other groups on the vocabulary test. Performances on both tests were positively correlated with the degree to which subjects reported having liked the music heard, but performances were unrelated to how "relaxing/nonrelaxing" the music was rated. Subjects who played instruments did not perform differently on the spatial test, contrary to the hypothesis that music training facilitates the development of spatial abilities.

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N. MARKS & J. HELLIGE. Hemispheric Asymmetry and Interaction in Number Recognition: Effects of Stimulus Format.

The present experiment investigated hemispheric asymmetry and interhemispheric interaction in number recognition. To shed light on the information processing locus of these effects, observers were required to identify number trigrams presented in the form of either Arabic digits or structured dot patterns similar to those on dice. Critical stimulus information was presented to the left visual field/right hemisphere (LVF/RH), to the right visual field/left hemisphere (RVF/LH), or to both locations simultaneously (bilateral redundant trials). Bilateral redundant trials, in which the 2 simultaneously presented stimuli represented the same numeric quantity, included a consistent condition for which both stimuli were in the same format (both digits trigrams or both dot trigrams) and an inconsistent condition for which the 2 otherwise redundant stimuli were in different formats (1 digit trigram and 1 dot trigram). When numbers were presented as Arabic digits, there was an RVF/LH advantage (LVF/RH $M = 35.5\%$ correct, RVF/LH $M = 49.7\%$ correct) and a hemispheric difference in processing strategy similar to that found for nonword letter trigrams. When numbers were presented as structured dot patterns, neither of these laterality effects was found (LVF/RH $M = 46.8\%$ correct, RVF/LH $M = 47.7\%$ correct). Identification accuracy was substantially higher on both consistent ($M = 64.8\%$) and inconsistent ($M = 59.7\%$) bilateral redundant trials than on either type of unilateral trial. However, identification accuracy was even higher for consistent than for inconsistent bilateral trials. Thus, some but not all of the advantage associated with redundant bilateral presentation is related to identity of stimulus format.

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S.M. WU, W.F. McKEEVER, & L. J. CERONE. Factor Analysis of the Combined Edinburgh and Annett Handedness Inventories.

Handedness is assessed by 1 of 3 methods: self-report of global handedness, writing hand, or handedness inventories. There has been debate as to whether handedness is a unidimensional or multidimensional trait. Several factor analyses on handedness inventory data have now been reported and suggest that handedness is multidimensional. Several problems remain, however, including the question as to whether left and right handed persons should be included in the same analysis (which tends to produce bimodal distributions), and the question as to the influence on the distribution when handedness is reported dichotomously rather than in a graded fashion. We conducted factor analyses on a composite inventory (18 items) created from the Edinburgh Handedness Inventory items (10) and Annett Handedness Inventory items (8). The study utilized a large sample of subjects (total $N = 1358$), and investigated the following questions: (1) What factors arise from a factor analysis of the traditional dichotomous (left/right) format as opposed to the 5-response (graded) format of the combined Edinburgh/Annett Inventory?; (2) Are different factor structures

found for left as opposed to right handed participants; and (3) Are different factor structures obtained for the 2 sexes. Results showed a 3-factor solution for the graded response format and a 5-factor solution for the dichotomous format. Left and right handed samples, and to a lesser degree, male and female samples, yielded unique factor solutions. General conclusions are presented and comparisons with previous studies are made.
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B. YOCHIM, R. KENDER, C. ABEARE, A. GUSTAFSON, & R.D. WHITMAN. Inter- and Intra-Hemispheric Semantic Priming and Thought Disorder.

This study examined hemispheric differences in the spread of semantic activation through a priming task. This priming task involved displaying prime words, then target words or nonwords and asking participants to make a lexical decision as to whether the target was a word or not. Priming occurs when participants make quicker decisions when targets are related to the prime words. Sixty undergraduate students completed priming tasks with primes and targets separated by 200 or 750 milliseconds (ms). Prime and target words were presented unilaterally to the same or opposite visual fields and were either directly related (school–book), indirectly related [lion–(tiger)–stripes], or unrelated (cup–street). Participants were also administered a measure of loose associations (the Thought Disorder Index used with the Rorschach). At 200 ms, participants exhibited significant priming effects to directly related words in all conditions except when primes and targets were both presented to the left visual field. Priming to indirectly related words was found at this SOA only when primes and targets were presented to opposite hemispheres. At 750 ms, there was significant priming for directly related words in all conditions, and for indirectly related words when primes were presented to the left visual field. Results suggest that the right hemisphere, within 750 ms, activates concepts both directly and loosely related to a prime stimulus. The left hemisphere processes information in a more focused manner even at 750 ms. The relationship between participants' performance on priming tasks and their scores on the loose associations measure is also discussed.
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E.M. SOETY & C.R. CIMINO Hemispheric Asymmetries on an Implicit Memory Task.

Research over the past 30 years has revealed a unique contribution of the right hemisphere (RH) to language processing. However, methodological difficulties, such as definition of relatedness and variability in reaction time have interfered with clearer understanding of this contribution. In this study, normal subjects completed a lateralized implicit memory task. Memory pairs varied by strength of associative relationship (weak or strong) and direction of relationship (forward, backward, or forward and backward). Analysis of the recall data revealed main effects of Visual Field (VF) (LH $>$ RH), Strength (strong $>$ weak), and Direction (forward = forward + backward $>$ backward). The VF $\times$ Strength interaction was also significant such that target recall was greater in the LH for strongly associated pairs; hemispheric differences were not found for weakly associated word pairs. The VF $\times$ Strength $\times$ Direction interaction approached significance ($p = .06$). *Post-hoc* testing revealed that target recall was greater in the LH than in the RH for studied pairs sharing a strong forward relationship. No other VF comparisons were significant. The mean of the RH trials did exceed the mean of the LH trials, with the word pairs sharing a weak forward association (RH, $M = 3.03$, $SD = .34$; LH, $M = 2.80$, $SD = .36$), though this difference was not statistically significant ($p = .599$). This pattern of results lends weak support to the depth of activation hypothesis, as the LH's advantage occurs with closely associated word pairs, while the RH does not differ in its ability to process closely or distantly related word pairs.
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E.M. SOETY, C.R. CIMINO, & H.N. TINSLEY. The Role of Association in Right Hemisphere Language Processing.

Numerous studies have revealed a right hemisphere (RH) advantage on certain language processing tasks. However, the conditions necessary for the RH advantage to emerge remain unclear, particularly with regard to word relationship. Some researchers posit that the advantage occurs with word pairs sharing a *categorical* but not *associative* relationship due to the RH's greater spread of activation, yet no studies have adequately controlled for association. In the first experiment, we were able to partially replicate the RH advantage found previously by Chiarello et al. (1990) using the same stimuli in a lateralized lexical decision task with a sample of normal subjects. That is RH priming $>$ LH priming was observed using unrelated–related reaction time as the dependent variable in a paired *t* test ($p = .055$).When analyzed as a 2-way ANOVA model with Visual Field and Relatedness (unrelated, related, neutral) as factors as in the Chiarello study, the Visual Field (VF) $\times$ Relatedness interaction was significant ($p = .026$) and the comparison of interest (RH unrelated *vs.* RH related trials) approached significance ($p = .093$). In the second experiment, all pairs from Chiarello's list sharing a direct association or an indirect association $>$ .03 were eliminated. Analysis of priming (unrelated–related reaction time) as a dependent variable was nonsignificant ($p = .195$) as was the VF $\times$ Relatedness interaction in the 2-way ANOVA ($p = .205$). Thus the RH advantage was eliminated with the removal of word pairs sharing direct and indirect connections of less than .03. In conclusion, it appears that some degree of *associative* relationship may be necessary for the RH advantage to emerge.
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C. ABEARE, N. MOSS, J. RAITER, & D. WHITMAN. Lateralization in Deep Dyslexia: A Challenge to the Right Hemisphere Hypothesis?

There have been 2 theories advanced to explain acquired deep dyslexia. The right-hemisphere (RH) hypothesis holds that the characteristic semantic reading errors (i.e., anger read as irritable) observed in deep dyslexia are due to relying on the RH for the orthographic and/or semantic components to reading (Colheart, 1980), due to left-hemisphere (LH) damage. The LH hypothesis holds that the semantic reading errors observed in deep dyslexia are due to the continued use of the LH for reading despite the incurred damage. However, little is known about the lateralization of language in developmental deep dyslexics and how it compares to that in acquired deep dyslexia. In the present investigation, a 51-year-old, right-handed developmental deep dyslexic (L.S.) was given visual half-field priming with a lexical decision task using high, low, and unassociated prime-target word pairs. In the LH, she had substantial priming for both high and low associates, unlike normals who prime much less and only prime for high associates. In the RH, she had no priming for high associates and substantial negative priming (inhibition) of low associates, unlike normals who will prime for both high and low associates in the RH. The LH activation of L.S. resembles that of the RH in normals and the RH has a peculiar pattern of strong inhibition of low associates. Results suggest that developmental deep dyslexia may result from developing a somewhat reversed asymmetrical lateralization of language such that the LH develops a processing style similar to the way a typical RH develops.
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J. SANCHEZ & G. HYND. The Corpus Callosum in Functional Lateralization: Activation or Inhibition?

A critical review of 2 opposing theories of the corpus callosum's role in hemispheric activation/inhibition and its impact on lateralization is presented. Lateralization of language and the ensuing hemispheric asymmetry is discussed in regard to interhemispheric connections. While most researchers believe that the corpus callosum permits interhemispheric transfer of information and plays an important role in the development of hemispheric asymmetry, the question remains as to whether the corpus callosum exerts an inhibitory or excitatory influence on interhemispheric communication. Several authors take the position that the corpus callosum

provides the pathway through which each hemisphere can inhibit the other in order to dominate a given function. Other authors posit that the corpus callosum serves an excitatory function and integrates information from both cerebral hemispheres. These 2 opposing theories are discussed in reference to the development of language, an extremely lateralized behavior. The theories are tested with review of the literature discussing the morphology of the corpus callosum in language disorders with special attention being paid to developmental dyslexia. In addition, comparisons are made between humans, nonhuman primates, and cetaceans, who have much more independent cerebral hemispheres and smaller corpus callosum relative to brain size than humans, in the context of these 2 theories. Implications of these findings on future neuropsychological research are addressed.

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A.M. BARRETT & M.K. NAGARAJAN. What, Where, and How Far: Spatial Bias in Aged Adults.

Spatial tasks may activate the right hemisphere, biasing subjects leftward. Western subjects drawing under unconstrained conditions may place drawings to the left of page center (categorical representations). They may also demonstrate leftward and far bias when bisecting lines (coordinate computations). We previously reported leftward bias on both of these tasks in Korean subjects, but the tasks were not correlated, suggesting that they may assess different visuospatial processes. We wished to learn if object drawing in American subjects correlates with line bisection, and whether American subjects demonstrate radial (far or distal) bias when drawing. Twelve subjects (6 women, 6 men, $M = 75.83$ years) bisected 10 (22-cm, 24-cm) lines and drew objects (house/tree/person). Mean line bisection error was 0.46 mm leftward (not significantly inaccurate). However, subjects centered drawings leftward (mean 9.36 mm leftward, $p = .004$). Radial displacement of drawings differed depending on what was drawn. Houses (8.17 mm, $p = .029$) and trees (7.25 mm, $p = .036$) were centered distally. People were drawn proximal to page center (mean 5.75 mm) but displacement was nonsignificant. As observed in Korean subjects, horizontal displacement on drawing and line bisection tasks were not correlated ($r = 0.039$; $p = .905$). Differences in performance of these 2 simple bedside tasks may reflect segregation of ventral "what" from dorsal "where" visual right hemisphere systems. However, implicit *versus* explicit instructional conditions may also affect performance.

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J. RAITER, C. ABEARE, N. MOSS, & D. WHITMAN. Time Course of Semantic Priming in the Left and Right Hemispheres.

One hundred and twenty subjects were presented with lateralized prime–target pairs that were high associates, low associates, or neutral in a lexical decision task. Six stimulus onset asynchronies (SOAs) varying from 20 ms to 750 ms were used (20 subjects per condition). Results confirm previous research suggesting a broader pattern of arousal of the lexicon in the right hemisphere and also suggest that the 2 hemispheres prime at different rates. The right hemisphere evidences priming earlier than the left hemisphere and continues to show a pattern of increasing and decreasing activation ahead of the left hemisphere in ipsilateral conditions. In contralateral prime–target conditions (rvf–lvf and lvf–rvf), priming was evident in the earliest condition, suggesting not only that priming is occurring within extremely short periods of time, but also that interhemispheric interaction is occurring as early as 20 ms after the presentation of a prime. Overall, time course is clearly important in the interpretation of priming results and the pattern of activation of the 2 hemispheres was consistent across subjects. This finding is critical to the interpretation of findings reported in the literature which use a limited number of SOAs and which neglect the early interaction of the hemispheres in lexical decision tasks.

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K. BAYNES, J. GILLETTE, E. MOSTOFIAN, D. LONG, & N. DRONKERS. Modes of Processing in the Right and Left Hemispheres of Aphasic Patients.

A number of developments have reinvigorated the hypothesis that the right hemisphere (RH) may play a role in recovery of reading. This study investigates the hemispheric processing of 2 aphasic patients who have made good recoveries from severe aphasic disorders. Although both subjects have recovered some reading comprehension, only EJ can effectively use writing to communicate. Verbal and written responses are free of semantic paraphasias. In contrast, WT continues to have difficulty using language to communicate, and makes semantic errors. His single word reading is relatively good. For these reasons, we hypothesized WT was dependent upon his RH lexicon, whereas EJ was not. The word superiority effect and serial position effect were examined in each visual field using a modification of the Reicher task. Our current results offer partial support for this hypothesis. Both subjects showed a word superiority effect in the RVF/LH. WT also showed a word superiority effect in his LVF/RH and a pseudoword effect in his RVF/LH. In contrast, EJ showed little advantage for words in his LVF/RH and no pseudoword effect. Both subjects showed the normal U-shaped curve in the RVF/LH and a serial position effect with decreasing accuracy for each successive letter in the LVF/RH. These results will be discussed in the light of studies that suggest there may be a course of recovery that depends upon nondominant hemisphere activation early on, but that fullest recovery depends upon recovered activity in spared cortical areas in the dominant left hemisphere (Weiller, 1998).

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K.L. OAKES, S.D. MARION, S.C. KILLIAN, E.D. THRASHER, K. McBURNEY-REBOL, & W.S. BROWN. Gender, Hormones, and Bimanual Coordination.

Gender and hormone differences have been examined with respect to a variety of cognitive tasks. Gonadal hormones (estrogen/progesterone and testosterone) produce differences in visuospatial and motor performance between males and females, and changes in the performance of females related to hormonal cycles (Janowsky et al., 1994; Gouchie & Kimura, 1991). This study examined the effect of gender and hormones on the computerized Bimanual Coordination Test (BCT), a task that measures visuomotor ability and interhemispheric integration. Two groups of normally menstruating adult females were tested on different days of their hormonal cycle: mid-luteal (corresponding to high levels of estrogen and progesterone), and menstrual (corresponding to low levels). Twelve males were also tested. Results indicated that males were significantly more accurate than females on bimanual trials requiring mirror image and same speed BCT knob turning (i.e., tracing a 135° path). There were no significant differences between males and females on trials requiring unequal hand speed (i.e., tracing 22.5°, 67.5°, 112.5°, and 157.5° paths). Analyses comparing the two groups of women revealed no significant effects of hormone level on bimanual coordination. These results replicate the male advantage on tasks requiring visuospatial performance found in previous research, but since no differences were found for trials involving unequal hand response speed, the data provide little evidence for gender differences in interhemispheric interactions. In addition, the data did not reveal any differences in bimanual coordination related to hormone levels in females.

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S. CHRISTMAN. Handedness and Sex Differences in Sarcasm Perception.

Previous research (Christman & Collins, 2001) reported a handedness × sex interaction in humor perception, with mixed-handed females exhibiting stronger senses of humor than strongly right-handed females, while strongly right-handed males exhibited stronger senses of humor than mixed-handed males. The current study explored individual differences in the perception of sarcasm. One hundred participants (22 mixed-handed females, 16 mixed-handed males, 44 strongly right-handed females, 18

strongly right-handed males) were presented with short scenarios that ended with either sarcastic or nonsarcastic comments, and judged on a 1–7 scale how sarcastic those comments were. There were no effects of handedness or sex for ratings of nonsarcastic comments. Ratings of sarcastic comments yielded a handedness × sex interaction ($p = .05$). Among females, mixed-handers exhibited significantly higher sarcasm ratings than strong right-handers. Among males, however, there were no handedness differences. Thus, mixed-handed females, relative to strongly right-handed females, exhibit stronger senses of both humor and sarcasm, while males show the opposite handedness effects for humor and no handedness effects for sarcasm. Results are interpreted in terms of the role in sarcasm perception of individual differences in interhemispheric interaction.
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M. LOPEZ, D. KOSSON, D. WEISSMAN, & M. BANICH. Assessment of Interhemispheric Integration in Psychopaths.
Deficits in the attention of psychopaths have been linked to intensive, transient activation of the left hemisphere. Although interhemispheric integration has been linked to attentional processing, the relationship between interhemispheric integration and attentional deficits in psychopathy is unknown. The present study examined the performance of a sample of 58 incarcerated psychopathic and nonpsychopathic males on a same–different global–local paradigm to determine whether the underlying cause of attention deficits in psychopaths is difficulty in interhemispheric transfer instead of, or in addition to, left hemisphere activation deficits. Results showed that criminal psychopaths generally benefited from interhemispheric integration in a manner similar to criminal nonpsychopaths. Consistent with the left hemisphere activation hypothesis, psychopaths responded more slowly than nonpsychopaths during trial blocks that required local processing (i.e., left hemisphere processing). However, psychopaths were also less accurate than nonpsychopaths during local trial blocks when interhemispheric integration was required. Thus, results were consistent with the left hemisphere activation hypothesis of psychopathy and further suggest that left hemisphere activation deficits may coincide with subtle interhemispheric integration deficits in psychopaths.
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D. HIGGINS & D. HARRISON. Sex Differences in Motor Asymmetry.
Functional asymmetry of the cerebral hemispheres has been a constant focus of research in neuropsychology—one of the most widely studied characteristics of the brain. Neuropsychological sex differences have been found in language, spatial, and emotional processing, through evidence of increased asymmetry in men compared to women for these tasks. Emerging evidence has extended these sex differences from cognitive, sensory processing, and emotional processing tasks to motor tasks. This study investigated sex differences in motor asymmetry in men and women. In a review of studies conducted at Virginia Tech that included the dynamometer for grip strength data, right-handed men consistently demonstrated asymmetry in motor functioning (right hand = 48.5 kg; left hand = 42.0 kg), while right-handed women evidenced symmetry in this aspect of motor performance (right hand = 30.3 kg; left hand = 30.0 kg). Moreover, in women, hand asymmetry on this task increased in the elderly (which also corresponds to increases in functional cerebral asymmetry for language in women with age). This was a remarkable finding, as right-handed men and right-handed women were both expected to evidence greater grip strength at the right hand, compared to the left hand. Results are discussed from a functional cerebral systems approach and contribute directly to the literature of neuropsychological sex differences. Furthermore, another perspective is discussed—as sex differences have been found in visual and auditory processing tasks, and now in motor performance. Thus, results from this study stimulate additional research into sex differences in fundamental cerebral systems.
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S.K. SMITH & W.F. McKEEVER. Inadequacy of Group Methods for Classifying Handwriting Postures.
There is renewed interest in handwriting posture (HWP) and its relevance for neuropsychology (e.g., McKeever, 2000). In the original method of HWP classification (Levy et al., 1976), the subject writes a sentence and the experimenter assesses HWP using strict criteria of hand and wrist position, and pen tip orientation. This method is relatively time-consuming, as it is applicable to only one subject at a time. Other more efficient methods of classification have been proposed. In the "prototypical pictorial examples" method (e.g., Coren et al., 1979), subjects compare their HWP to pictures depicting inverted (IHP) and noninverted handwriting posture (NHP). Levy (1984) proposed a second method of classification suitable for group testing, in which subjects answer 4 written questions to evaluate their own HWP. We investigated the agreement between experimenter classification and the "more efficient" methods ($N = 150$). The pictorial method showed 84.7% agreement, and the verbal description method showed 56.7% agreement with experimenter-classified HWP. Females who misclassified their HWP with the pictorial method were significantly more likely to have a positive history of familial sinistrality. Some relationships of laterality quotients to misclassification were also found. While neither alternative method is wholly adequate for classifying HWP, the pictorial method could be useful for group testing when samples so large as to preclude individual testing are needed to address a particular research question.
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R. PROPPER & B. SIMON. Strongly-Handed Old and Weak-Handed Young Students Report Similar Sleep Patterns.
Total sleep time decreases as age increases (Roffwarg, Muzio, & Dement, 1966). Interestingly, in undergraduate populations, the weakly-handed (WH) report needing less sleep than the strongly-handed (Hicks, 1979; Propper, 2000). Here, we compare handedness and age differences in self-reported measures of sleep time and other self-reported sleep measures. *Method:* 91 undergraduate women reported their average sleep per night, desired amount of sleep, dreams recalled per week, nightmares recalled per week, month, and year, and filled out the Edinburgh Handedness Inventory (EHI; Oldfield, 1971). *Results:* 3-way ANOVAs [Strongly-Handed Older (SO: $n = 18$, EHI ≥ 70); Strongly-Handed Younger (SY: $n = 57$; EHI ≥ 70); Weakly-Handed Younger (WY: $n = 16$, EHI $\leq +65$ and ≥ -65)] were performed on age and answers to all other questions. SO were older ($M = 32.33$, $SE = 2.42$) than both younger groups, who did not differ from each other (SY: $M = 19.68$, $SE = 15$; WY: $M = 19.38$, $SE = .35$) [$F(2,88) = 54.39$, $p < .01$). The SY reported getting the greatest amount of sleep ($M = 7.27$, $SE = .16$) compared to both other groups, while the WY ($M = 6.61$, $SE = .29$) and SO ($M = 6.11$, $SE = .22$) did not differ from each other, $F(2,88) = 7.44$, $p < .01$. These results were paralleled in desired sleep, $F(2,88) = 4.29$, $p < .05$; SY: $M = 9.06$, $SE = .23$; WY: $M = 8.22$, $SE = .18$; SO: $M = 8.08$, $SE = .17$. All groups reported wanting more sleep than they were getting (paired t tests, $p < .01$ for all comparisons). No other effects were significant. *Discussion:* Similarities in sleep needs between the WY and SO may reflect the anomalous cerebral organization of the WY on the one hand, and developmental neuroanatomical changes in the SO on the other.
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Poster Session 6/3:00–5:30 p.m.

CALLOSAL STUDIES

T. EVERETT, K. SCHILMOELLER, & G. SCHILMOELLER. Callosal Agenesis and Attention Deficit Hyperactivity Disorder: A Connection?
Children with callosal agenesis often exhibit behaviors commonly associated with attention deficit hyperactivity disorder (ADHD) and face the

question of a dual diagnosis. We surveyed 1700 families of individuals with callosal agenesis to obtain data that would describe the behavioral tendencies of these school-aged children with respect to ADHD symptoms. Of the 383 surveys returned, 309 represented children without an ADHD diagnosis and 74 represented children with both callosal agenesis and ADHD diagnoses. Using Diagnostic and Statistical Manual (DSM–IV) measures, 52.5% of the 309 children without ADHD could meet criteria for ADHD-Inattentive subtype, 28.5% for ADHD-Hyperactivity/Impulsivity subtype, and 23.7% for ADHD-Combined subtype. Using Swanson, Nolan, and Pelham Questionnaire (SNAP–IV) measures, 77% of the 309 children with an ADHD diagnosis could meet criteria for ADHD-Inattentive subtype, 71% for ADHD-Hyperactivity subtype, and 62.6% for ADHD-Combined subtype. Thus, inattention appears to be a prevalent characteristic of children with callosal agenesis. Further analyses revealed that there was no difference in behaviors reported by families of children with complete *versus* partial callosal agenesis. This study also identified perceived advantages and disadvantages of such dual diagnoses.
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J. GRIGSBY, J. HILLS, R. WILSON, M. LEEHEY, R. J. HAGERMAN, F. TASSONE, & P. J. HAGERMAN. Dysexecutive Syndrome in Older Men with Action Tremor and the Fragile X Premutation.
Fragile X syndrome (FXS) is a trinucleotide (CGG) repeat disorder. The full mutation (an expansion > 200 repeats) is associated with neurologic and neuropsychological deficits, ranging from essentially normal functioning through significant mental retardation. Persons with 55–200 repeats (carriers) are said to have the FXS premutation. Though it has been widely thought that carriers are unaffected, mild deficits have been observed, especially in executive functioning. In addition, we recently described a previously unidentified progressive neurologic disorder in a subset of older (age 62–79) male premutation carriers of FXS. The disorder is characterized by tremor, attaxia, dystonia, sensory loss, and cognitive decline. Here we report findings from the WAIS–III and 5 tests of executive functioning—the Wisconsin Card Sort (WCST), Animal Naming (AN), Controlled Oral Word Association (COWA), Stroop Test (ST), and Behavioral Dyscontrol Scale (BDS)—in a series of 8 premutation males (78–100 CGG repeats) aged 62–79, identified in a pedigree study of families of children with FXS. All showed moderate (5/6) or mild to moderate generalized atrophy on MRI. For this group, with a significantly above average level of education, the means were: age = 69; CGG repeats = 92; %FMRP = 78.5%; mRNA = 233% of normal; VIQ = 94.2; PIQ = 79; WCST categories = 1.2; WCST perseverative errors = 76; COWA words = 16; AN = 11; ST word, color, & color-word scores were 1.6 to 1.9 *SD* below normative means; mean BDS score was 2.3 *SD* below normative means. These data were consistent with behavioral observations of disinhibition and impaired insight, and indicate the disorder is associated with significant deficits in several different aspects of executive functioning.
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G. SCHILMOELLER, P. MOES, K. SCHILMOELLER, & E. NOWAK. Agenesis of the Corpus Callosum: Physical, Social, and Cognitive Characteristics.
Over 2000 individuals with agenesis of the corpus callosum (ACC) have been identified, but only small groups have been studied previously. We surveyed 1,900 families of individuals with ACC to establish a comprehensive picture of the behavioral, cognitive, and social outcomes associated with ACC. To date, 678 surveys have been returned, from which we identified 157 individuals (98 total ACC; 59 partial ACC), ages 5 and older (67% males and 33% females) who were free of severe cognitive deficits, based on their age-appropriate communication ability. Compared with normative data, individuals in this sample were less likely to be consistent right-handers (67%) and more likely to be delayed in meeting early developmental milestones for walking and saying their first words. Many individuals with ACC were reported to have learning disabilities (42%), mental retardation (17%), ADD or ADHD (22%), or obsessive compulsive disorder (12%). Cognitively, these individuals had difficulty with abstract reasoning (73%) and staying on task (59%), but most reported good memories (73%). Most school-age individuals were in a regular classroom (70%), but many received special help (42%). Socially, they were reported as being almost always happy (86%) and content (79%), but 46% reported having difficulty using appropriate personal space. In general, there are clear indications of behavioral, cognitive, and social deficits in individuals with ACC. Further analyses revealed that the deficits are generally *more* pronounced with *partial* ACC than with complete ACC, despite no difference in the presence of concurrent neurological disorders.
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P.I. MARTIN, S.E. SCZERZENIE, M.A. NAESER, & E.H. BAKER. Corpus Callosum Atrophy in Chronic Stroke Patients with Aphasia.
Structural magnetic resonance imaging (MRI) was used to examine the corpus callosum (CC) of chronic stroke patients with nonfluent aphasia. The purpose of the study was two-fold: (1) to compare the overall size of the CC and area of its 7 subsections between aphasics and controls and (2) to determine whether among aphasics extent of lesion in specific cortical and subcortical white matter regions predicts area of each CC subsection. Seven aphasics (47–59.5 yr, 2–6 years poststroke) and 7 age-matched controls were studied. Mid-sagittal MRI slices were digitized and converted from pixels into mm^2. Measurements were taken using the imaging analysis software program, Alice (v.2.4). The CC was outlined and segmented into 7 subsections (Witelson, 1989). *T* tests were used to compare data between the aphasia and control groups. Aphasics had significantly smaller overall area of the CC ($p < .003$, aphasics, $M = 54.3$, $SD = 14.9$, controls, $M = 90.5$, $SD = 11.4$). Aphasics also had significantly smaller areas for each subsection 2–7. No significant difference in length of the CC or area of the brain at this mid-sagittal slice was found. Among the aphasics, multiple regression was used to predict area of each subsection of the CC based on extent of lesion within specific cortical and subcortical white matter regions. No significant findings were observed. Results suggest atrophy in the CC in chronic stroke patients with aphasia is associated with a generalized decrease in left-right interhemispheric connections. This atrophy may play a role in aphasia severity and recovery.
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P.A. MULLIN, W.S. BROWN, C. GRILLS, S.C. KILIAN, M. HARRINGTON, & G. BLESI. Interhemispheric Transfer in Alzheimer's Disease: Crossed-Uncrossed Reaction Time Difference and N1 Latency in Visual Evoked Potentials.
Atrophy of the corpus callosum has been demonstrated in the magnetic resonance images (MRIs) of Alzheimer's disease (AD) patients. However, the functional consequences of callosal atrophy are not clearly understood. The present study assessed interhemispheric transmission time (IHTT) in AD using both behavioral and physiological measures. Participants were 13 AD patients and 13 age-matched controls who volunteered for testing at a medical research institute as part of a study looking for protein markers in AD. All 13 patients were suffering from mild to moderate impairment as measured by the Mini-Mental Status Exam (scores between 14 and 26). Two measures of IHTT, N1 latency to visual evoked potentials (VEP) and crossed-uncrossed reaction time difference (CUD), were recorded to assess callosal function in AD. For calculation of the CUD, right and left handed reaction times to brief lateralized presentations of simple GO/NOGO stimuli were measured. In addition, VEPs were recorded from right and left hemisphere temporal-parietal placements. N1 peak latencies were measured from the 4 combinations of visual field and hemisphere. Results of the reaction times revealed a significant hand by visual field interaction, indicative of a significant CUD. However, this effect did not interact with group. Similarly, a significant visual field by hemisphere interaction was found for VEP N1 latency, but this study

did not find a significant group × visual field × hemisphere interaction. Taken together these results indicate that mild to moderately impaired patients with AD do not differ from controls in the speed of callosal transfer.

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A.A. TURK, A. KATCHICHIAN, L.K. PAUL, & W.S. BROWN. Semantic Analysis of the Emotional Content of TAT Protocols of Individuals with Agenesis of the Corpus Callosum.

Individuals with agenesis of the corpus callosum (ACC) and normal IQ are reported to have difficulty processing subtle and complex social and emotional content. These deficits in psychosocial insight have been explained either as a nonverbal learning disability or as alexithymia (the inability to express emotion in language). In this study, transcribed stories for 6 Thematic Apperception Test (TAT) cards from 10 normally intelligent (IQ $>$ 80) individuals with ACC were compared to the stories of 15 age- and IQ-matched controls. Differences in semantic content were analyzed using the Dartmouth adaptation of the General Inquirer (GI) program (Tucker & Rosenberg, 1975), which uses the Harvard Psychosociological Dictionary (Stone et al., 1966) to categorize words into Theme Headings. The difference between groups in total number of words was not significant. Despite the fact that individuals with ACC were given more queries asking what the characters in the story were feeling than were controls, GI classified fewer words into emotional categories for individuals with ACC than for matched controls (for Cards 1 & 2, $p <$ .005). Thus, the complex emotional content of the TAT cards did not elicit as much emotional content from individuals with ACC. Simple, concrete social perceptions were expressed by individuals with ACC using repetitions of phrases or concepts that were lacking elaboration of emotional content. Therefore, the fact that parents of ACC children report having difficulty knowing what their child is feeling or experiencing (O'Brien, 1994) may be related to alexithymia.

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Poster Session 6/3:00–5:30 p.m.

DYSLEXIA

J. INGLES & G. ESKES. Temporal Processing Deficits in Letter-by-Letter Reading.

In the acquired reading disorder known as letter-by-letter (LBL) reading, words can only be pronounced after each letter is identified individually. One prominent theory of LBL reading proposes that the disorder results from difficulty in processing multiple letters simultaneously. The current study investigated whether this deficit also extends to letters presented in rapid temporal succession. A LBL reader, G.M., was tested using a rapid serial visual presentation task that has been used widely to study the temporal characteristics of the normal visual system. Comparisons were made to a control group of 6 brain-damaged individuals without reading deficits. Two target letters were embedded at varying temporal positions in a stream of rapidly presented digits (100 ms/item display rate). After each stream, the identities of the 2 letters were to be reported. G.M. required an extended period of time (1200 ms) after he had processed one letter before he was able to reliably identify a second letter, relative to the controls (700 ms required). In addition, G.M.'s report of the second letter was most impaired when it immediately followed the first letter, a pattern not seen in the controls, indicating that G.M. had particular difficulty processing the 2 items together. These data suggest that patients may adopt a LBL strategy in reading to help compensate for a deficit in the temporal processing of letters. The specificity of this deficit for orthographic materials warrants further study.

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M. LOVETT, J. FRIJTERS, K. STEINBACH, M. De PALMA, M. TEMPLE, N. BENSON, R. SEVCIK, M. WOLF, & R. MORRIS. The Comorbidity of Reading and Math Disorders in Children With Reading Disability.

One hundred eighty-four children in grades 2 and 3 referred for reading acquisition problems were confirmed to be significantly delayed in reading achievement on multiple standardized measures (Mean WRMT–R Total Reading s.s. = 77.8, *SD* = 11.1). These subjects received a battery of experimental and standardized tests before, during, and after participating in remediation in Toronto, Boston, and Atlanta. Children were divided into 2 groups based on mathematics achievement standard scores (RD-alone *vs.* RD + MD), and a range of diagnostic measures used to evaluate their predictive value in differentiating the 2 groups using a logistic regression model. The 2 groups were found to differ in the severity of their reading disability and in WISC–3 VIQ and PIQ. When a logistic regression model was constructed including WRMT–R Total Reading scores, VIQ and PIQ, only the total reading score and VIQ contributed significantly to prediction of RD-alone *versus* RD + MD status. Of subjects 72.8% were correctly identified with this model. Prediction accuracy increased to 80% when the model expanded to include a composite RAN naming speed score, naming errors on RAN digits, a difference score comparing right and left finger tapping, and a total visual motor integration score (Beery). These analyses reveal a small set of specific predictors that characterize the different profiles of children with reading disability alone *versus* reading and math disability. The severity of the disability experienced by the comorbid group early in the elementary grades argues for the importance of early intervention and early systematic multifocus remediation.

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N. BENSON, M. TEMPLE, M. LOVETT, J. FRIJTERS, K. STEINBACH, & M. De PALMA. Generalization of RD Children's Treatment Gains to Multisyllabic Word Reading.

Transfer-of-learning to uninstructed content remains a challenge in the treatment of dyslexia. Two 35-hour word identification training programs for disabled readers (RD) were compared. The WIST Program trained 4 metacognitive decoding strategies, while PHAB provided direct instruction in phonological and decoding skills. A control program offered no instruction in reading. Pre- and post-treatment transfer tests were administered to 94 disabled readers (7–14 years) randomly assigned to treatment. Multisyllabic transfer probes compared children's identification of words systematically graded according to affix complexity (1–3 affixes) and subsyllabic similarity to instructed keywords. Transfer probes either shared the keyword's rime, onset plus vowel(s), outer consonant(s), complete spelling pattern, or contained a novel word segment. Results revealed that WIST- and PHAB-instructed children exhibited superior pre- to post-testing transfer at all levels of complexity ($ps \leq .001$), and across all transfer categories ($ps < .05$). Transfer performance decreased as word complexity increased ($p < .05$) and varied as a function of transfer category ($p < .001$). Treatment-specific transfer effects were reflected in the fact that strategy-trained WIST participants could decode increasingly complex words with greater accuracy relative to phonologically-trained PHAB participants ($p < .05$), and scored higher on transfer words containing embedded keywords ($p < .001$) and keyword rime units ($p < .01$), as demonstrated by *post-hoc* contrasts. There were no significant differences between treatment groups on words with variable vowels and back segment transfer. These positive results suggest that generalization of learning for reading disabled children is facilitated by training of multiple metacognitive decoding strategies.

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R. BARRON, J. FRIJTERS, M. LOVETT, K. STEINBACH, M. DE PALMA, M. TEMPLE, N. BENSON, A. BURHANPURKAR, R. SEVCIK, M. WOLF, & R. MORRIS. Speech Perception and Core Processing Deficits in Developmental Reading Disability.
Deficits in core phonological processes (e.g., phonological awareness) and naming speed (e.g., rapid serial naming) are regarded as defining features of developmental reading disability. Since phonological processing involves initial speech perception, deficits in basic speech perception should be reflected in deficits in phonological processes. We identified 2 subgroups from a larger group of children with developmental reading disability ($N = 208$) who differed substantially in categorical speech perception measured with a b/ to /p/ voice onset rime (VOT) task. The slope group ($N = 46$) had the characteristic rising S-shaped function across VOT values (0–45 ms) while the flat group's ($N = 90$) performance did not change. Consistent with previous research showing weak relationships between measures of phonological processing and speech perception, the 2 groups did not differ in phonological awareness (elision and blending) ($p > .25$). They also did not differ on rapid serial naming measures (RAN times for letters, numbers, objects) ($p > .25$), Woodcock Word Identification and Word Attack measures of word reading ($ps > .20$), and WISC Full Scale IQ ($p > .15$). The slope group did, however, have superior performance on measures of finger tapping speed (left hand $ps < .04$, right hand $ps < .04$), WISC Similarities ($p < .005$), and WRAML Story Memory ($p < .008$) suggesting that deficits in speech perception may index motor and language disorders rather than reading disorders *per se*.
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K. STEINBACH, M. DE PALMA, J. FRIJTERS, M. LOVETT, M. TEMPLE, N. BENSON, M. WOLF, & R. MORRIS. Differential Influences on RD Children's Phonological Processing and Naming Speed.
Phonological processing and naming (RD) speed have been widely documented as distinct deficits in disabled readers (RD). Using 6 timed tasks, the unique contribution of different rapid processing and motor skills potentially related to phonological processing and naming speed deficits in RD was investigated in 136 second and third grade disabled readers. These measures were entered into a principal components analysis using a varimax rotation to obtain a small set of independent components accounting for maximum variance. Three factors were extracted accounting for 74% of the variance. Factor 1 was labeled Ortho-phonetic speed and represented speed of word and passage reading (27% variance). Factor 2, labeled Grapho-motor speed, represented the WISC–III Processing Speed Factor (26% variance). Factor 3 was labeled Motor-movement speed and represented basic motor output (PANESS tongue wiggles and right-hand finger tapping; 21% variance). Independent contributions of these factors to phonological processing and naming speed using a hierarchical regression revealed that all 3 factors significantly predicted phonological processing skills ($ps < .001$ to $.05$), while only Ortho-phonetic speed was a significant predictor of naming speed ($p < .001$) with Grapho-motor speed approaching significance ($p < .10$). These results highlight the distinctiveness of these 2 core deficits. A range of rapid processing and motor tasks relate to individual differences in disabled readers' phonological skills. Only tasks requiring rapid print-to-sound translation relate to naming speed.
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J. FRIJTERS, M. LOVETT, N. BENSON, K. STEINBACH, M. DE PALMA, M. TEMPLE, M. WOLF, & R. MORRIS. Word Identification Speed and Learning Transfer of Reading Disabled (RD) Children.
One focus of current remedial reading interventions is training children to identify a corpus of words containing high-frequency spelling patterns in the English language. The present study provides evidence that children's speed in identifying such words (i.e., measured by voice-onset time in oral identification of computer-presented words) may facilitate transfer to words with related spelling patterns. In a hierarchical regression model, RD children's ($N = 108$) scores on a measure of uninstructed transfer words were first regressed onto 2 known predictors of word identification accuracy, rapid automatized naming speed, and phonological ability (accounting for 47% of the variance, $p < .001$). After then controlling for instruction-related individual differences in onset and rime spelling pattern knowledge (20%, $p < .001$), keyword identification speed accounted for significant additional variance in transfer accuracy (2%, $p < .01$). In contrast, speed in identifying untrained words did not predict transfer word accuracy. *Post-hoc* analyses demonstrated that faster speed in keyword identification (median latency < 1000 ms) may be a prerequisite for superior outcomes on measures of transfer word learning. Fifty-nine percent of children who identified keywords quickly attained superior transfer performance, whereas only 16% of those who did not demonstrate latencies less than 1000 ms ($p < .01$) did so. These results suggest that training to automaticity in the identification of high frequency keywords may be critical to achieving transfer of learning within the word identification domain for RD children.
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C.R. MONTGOMERY, R. MORRIS, R. SEVCIK, & M.G. CLARKSON. Temporal Auditory Processing in Children with Reading Disabilities: Masking Thresholds.
Previous research has suggested that children with language learning disabilities may have an underlying auditory temporal processing deficit. In that work, 8 children diagnosed with specific language impairment were found to have faulty auditory temporal processing of backward masking stimuli. Given the small sample size and restricted sampling criteria, replication is necessary. The present research evaluated 52 7- to 10-year-old children (half having reading disabilities) in a conceptual replication of the study described above. Subjects attained either (1) an IQ > 70 and a reading-achievement scaled score of 85 or below, or (2) an IQ > 70 and a reading regression-corrected discrepancy 1 *SE* or greater of the estimate. Each of 6 experimental conditions was presented in the following order: (1) a Backward Masking Unnotched condition; (2) a Simultaneous-Onset Delay Masking Unnotched condition; (3) a Simultaneous-Onset Delay Masking Notched condition; (4) a Forward Masking Unnotched condition; (5) a Backward Masking Notched condition; and (6) a Forward Masking Notched condition. Subjects were tested in a single-interval, yes/no procedure with maximum-likelihood estimation of threshold. A threshold estimate was obtained for each subject in each of the 7 conditions. Stepwise multiple regression analyses were conducted on all subjects for each threshold condition, with reading disability status, age, and nonverbal IQ entered as predictor variables. Reading disability status was the only significant predictor of performance in the Backward Masking Notched and Backward Masking Unnotched conditions, indicating a possible temporal auditory processing deficit among children with reading disabilities.
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C. MILLER, J. CRAGGS, G. HYND, & S. MILLER. Predicting Dyslexia with Double Deficit Performance and Planum Temporale Length.
Although the exact diagnostic criteria for dyslexia is not established, most experts agree the criteria should include either significantly subaverage reading achievement or a significant discrepancy between reading achievement and cognitive ability. The double-deficit theory of dyslexia suggests the true underlying deficits in dyslexia are in rapid naming and phonological processing. Advanced neuroanatomical imaging techniques have implicated the planum temporale in reading comprehension and phonological processing. From an existing clinic database, 31 subjects diagnosed with dyslexia by 2 independent psychologists were selected. Planum temporal measurements were made for a smaller subsample, and a ratio for left *versus* right planum temporale was calculated for each subject, with re-

sults indicating an unusual level of plana symmetry within our clinic sample. Using linear regression to predict 2 different outcomes, models using the plana ratio, a measure of phonological processing, and a measure of rapid naming were derived. When the regression equation was used to predict basic reading performance, phonological processing predicted reading achievement. Neither rapid naming nor the plana ratio had significant power to independently predict reading performance. A second model to predict the discrepancy between basic reading and FSIQ indicates that double deficit performance does not predict the discrepancy, but rapid naming and phonological processing are highly correlated. In this model, the length of the plana significantly predicted the discrepancy. Therefore, phonological processing influences basic reading ability, while the plana influences the relationship between cognitive ability and basic reading performance.

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J. INGLES & N. PARK. Treatment of Letter-by-Letter Surface Alexia.

A reading treatment program was implemented with a patient, G.M., who acquired dyslexia following a left temporal-occipital hemorrhage. In baseline sessions prior to treatment, G.M. showed stable characteristics of both letter-by-letter reading (i.e., increase in reaction time with increasing word length) and surface dyslexia (i.e., inaccurate pronunciation of irregular words). A 15-week, intensive treatment protocol was administered in which G.M. practiced oral reading of 240 single words and was provided with feedback on accuracy and speed. Following treatment, his oral reading performance for the trained words, as well as for a set of untrained words, was assessed. For the trained words, accuracy improved significantly (>90% for irregular words); overall reaction time decreased and was less affected by word length. At a 3-month post-treatment assessment, these gains in reading performance were maintained. For the untrained words, however, there was no improvement in accuracy or reaction time compared to the pretreatment level of performance. These results indicate that, at least in this case of acquired dyslexia, reading can improve with ample practice, but the treatment effects are specific and do not generalize to the reading of untrained words. Further research is required to determine the underlying cognitive mechanisms responsible for the improved performance and to develop efficient training procedures that may facilitate generalization.

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R. TUNICK, N. RAITANO, R. BOADA, & B. PENNINGTON. Alphabet Knowledge in Children with Speech and Language Disorders.

Alphabet knowledge, including both letter-name (LN) and letter-sound (LS) knowledge, has been found to be a strong predictor of later reading ability in preliterate children (e.g., McBride-Chang, 1999; Scarborough, 1990; Bradley & Bryant, 1983). There is also a large body of research indicating that children with early speech and/or language disorders, including Phonological Disorder (PD) and Specific Language Impairment (SLI), are at an elevated risk of exhibiting later reading disorders (i.e., dyslexia, or RD) (e.g., Elbro, 1998; Gallagher, Frith, & Snowling, in press). However, little research has examined the alphabet knowledge of preliterate children with speech and/or language disorders. Such research would help to clarify both the cognitive phenotype of these disorders, as well as the relation between these disorders and later RD. The present study investigated the performance of 36 children (ages 5 to 7) with either PD alone, PD + SLI, or no history of speech and/or language problems on several measures of alphabet knowledge: LN, LS, and letter writing. After covarying age, there was a significant difference between each of the clinical groups and the control group on the LS task, such that subjects in both of the clinical groups were less accurate than controls at spontaneously producing the sounds that letters make (p's $< .05$). The PD + SLI group also performed significantly worse than the controls on the letter writing task ($p < .01$). Finally, alphabet knowledge was found to be related to measures of phonological processing, particularly tasks tapping sound matching and rapid object naming abilities.

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N. RAITANO, R. TUNICK, R. BOADA, B. PENNINGTON, & M. CLARKSON. Temporal Auditory Processing in Children with Speech/Language Disorders.

Some research has indicated that children with specific language impairment (SLI) and/or reading disability (RD) have deficits in the rapid temporal processing of auditory stimuli. However, recent research has suggested that only a subgroup of these children present with such deficits. Additionally, little research has investigated the auditory temporal processing abilities of children with a related condition, phonological disorder (PD). Thus, the present study investigated the performance of 30 children (ages 5 to 7) with either PD, PD + SLI, or no speech/language disorder on an auditory masker task with 4 conditions—backward masking, backward masking with notched noise, forward masking, and simultaneous masking with a long tone. Preliminary results revealed a trend such that children in the PD and PD + SLI groups performed more poorly overall on the masking task than controls ($p < .1$). Additionally, these initial results demonstrated that children with PD + SLI differed from the controls on the simultaneous long tone condition ($p < .05$), but not on the backward masking condition as others have found. These preliminary results will be further explored with a larger sample of children. Additionally, other factors that may be contributing to group differences (e.g., attention) will be examined to understand these inconsistent results. Finally, a preliminary analysis of performance on phonological awareness tasks (e.g., rhyming) suggests a relation with several auditory masking conditions, such that lower tone detection thresholds were associated with higher scores on phonological awareness tasks.

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A.L. HOLLINGSWORTH, A.M. CIMINO-KNIGHT, K.M. HEILMAN, H. ROTH, & L. J. GONZALEZ-ROTHI. Atypical Phonological Alexia: Unusual Pattern of Deficits in Reading Aloud.

Traditional cognitive neuropsychological models of reading posit 2 routes to reading aloud, a lexical/semantic system used to read irregular as well as regular words (including functors), and a sublexical/phonological system to read regularly spelled words and nonwords. This approach predicts poor nonword reading in both phonological and deep dyslexia, both proposed to involve a deficient phonological system. Additionally, poor functor reading and semantic errors are predicted in deep dyslexia but not in phonological dyslexia. We report a pattern of deficits in an alexic that was inconsistent with the predictions of this model and what has been noted in deep and phonological dyslexia in that he was unable to read nonwords, able to read all classes of real words including functors, but also made semantic errors in reading. To account for this inconsistency, we propose a 3 route model of reading that allows for activation of phonology by direct grapheme-to-phoneme transcoding, activation from the orthographic input lexicon, and activation through semantics, while also allowing for different methods of processing for functors and content words. According to this model, deep dyslexics primarily use the semantic route leading to semantic errors and the inability to read functors which do not have semantic representations. Phonological dyslexics use both the semantic route and orthographic-phonological route resulting in the ability to read all classes of real words but do not make semantic errors because of the mediating connection between the orthographic input lexicon and semantics. In contrast, our patient is using both the semantic and orthographical-phonological routes, and can thus read both content words and functors, but makes semantic errors because of the loss of the mediating connection between orthographic input lexicon and semantics.

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Poster Session 6/3:00–5:30 p.m.

GENETICS

E. GINDINA. Neuropsychological Analysis of Psychological Functions in Twins.
The present paper proposes and advocates the neuropsychological approach (the systemic analysis of the psychological functions in relation to the morphofunctional brain structures) to the examination of the genotype–environmental determination of individual psychological differences. The concept of systemic dynamic localization of psychological functions developed by A.R. Luria's school, the use of the syndrome approach methodology in the comprehensive study of higher psychological functions united by common system-forming components—factors—make it possible to identify the unit of genetic analysis, factor, and examine the psychological functions in their unity and relatedness. This resolves the main problem of genetic analysis of mental functions, which arises from the latter's complex character. The pilot study using the classical twin method was performed to "test" the applicability of neuropsychological methodology to the study of genotype–environmental influences on individual differences in psychological factors. Five pairs of monozygotic (MZ) and 5 pairs of dizygotic (DZ) twins and the control group of 10 singleton children aged between 11.5 and 12 years were assessed using Luria's battery of neuropsychological tests adapted for children. Dissimilar patterns of genotype–environmental determination for different neuropsychological factors were revealed. At the psychological level, data indicating hemispheric distinctions in the degree of genetic influences were obtained. Individual differences in the function's parameters, associated mainly with the right hemisphere, showed a greater contribution of hereditary factors. Further study could also focus on twins' differences compared to singletons.
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W.F. McKEEVER & P.P. VAN EYS. X-Linked Association of Handwriting Posture and Familial Sinistrality.
McKeever & Van Eys (1989) reported that left-handed writers who employed the inverted handwriting posture (IHP) had significantly more left-handed relatives than did left-handed writers who employed the noninverted handwriting posture (NHP). The difference between NHP and IHP families was particularly large for maternal families, although the authors noted that the difference was also present, *across* male and female subjects, for paternal relatives. Recently, McKeever (2000) reported a large family handedness breeding ratio sample that showed a clear pattern of X-linkage. An X-linkage model would predict, if HWP is a genetically influenced trait, that the IHP–NHP differences in familial sinistrality should be present in both maternal and paternal families of female subjects, but only in the maternal families of males. McKeever and Van Eys had no reason to suspect X-linkage in 1989 and did not look for possible hand posture/familial sinistrality interaction with subject sex. We now report such an analysis for the 471 families of McKeever & Van Eys. Results showed that families of IHP females included significantly more left-handed persons than did the families of NHP females and this was true in *both* maternal and paternal families. The IHP males had significantly more left-handed maternal relatives than did NHP males, but IHP and NHP males did *not* differ in the incidence of left-handed paternal relatives. Results are consistent with X-linkage of the handwriting posture–familial sinistrality patterns.
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W.F. McKEEVER. A Viable Single Gene, Three Allele, X-Linkage Model of Handedness.
McKeever (2000) reported a large-scale family handedness study that was consistent with an X-linked pattern of inheritance of handedness. He suggested that an X-linked genetic model could account for 2 effects that are poorly handled by the prevailing genetic models of Annett and of McManus. These effects are the "maternal effect" (left-handed mothers produce more left-handed children than do right-handed mothers), and the "sex effect" (left-handedness is more common in males than females). A traditionally-cited "fatal flaw" of X-linkage, however, is said to be that it would require a *much* higher incidence of left-handedness in males than in females, while left-handedness is only slightly more common (about 2%) in males than females. Both Annett and McManus have explicitly pronounced X-linkage to be nonviable because of this. The "flaw," however, exists only if one hypothesizes complete dominance of a "right hand" allele. This paper details an X-linked, 3-allele model designed to predict both handedness and handwriting posture frequencies of sinistrals of the 2 sexes. The model predicts an overall incidence of sinistrality of 10.02% of females and 12.00% of males, and closely predicts the frequencies of left-handed offspring for the various combinations of parental handedness, as found by McKeever (2000), and it also predicts quite well the sex-differentiated incidence of inverted and noninverted handwriting postures we found in previous studies. The model demonstrates that an X-linked gene model for handedness is, in fact, viable.
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M.A. GARCÍA, D.A. PINEDA, J.D. PALACIO, G.C. HENAO, Y.T. QUIROZ, M. ARCOS, M. ÁLVAREZ, M. OCAMPO, & F. LOPERA. Familiar Aggregation in Two ADHD Antioquian Families.
Complex segregation analysis on Antioquian nuclear families ascertained from affected probands suffering from ADHD suggested the existence of a major gene that explained more than 99.99% of phenotype variance. According to major gene contrasting models this gene would have dominant or co-dominant characteristics, and a 30% penetrancy was estimated (Lopera et al., 1999). The aim of this study is to present the pedigree of two multigenerational Antioquian families with several ADHD members. Genealogies were constructed with Cyrillic 3.0 software. Neurological, neuropsychological, and psychiatric assessments were performed on all families' members. The selection criteria were: (1) to have more than one diagnosed ADHD case; (2) both parental lines belonging to the "Paisa" community; (3) being multigenerational; (4) to have affected probands in only one parental line; and (5) all members accepted to participate, signing informed consent. The two pedigrees presented were from "Paisa" multigenerational families. The first family (PP) has 22 members, with 5 definite ADHD participants. The second family (RG) has 27 members, with 7 ADHD affected members. The software codified each member in the genealogic tree, using DSM-IV criteria and *T* score of DSM IV-ADHD Checklist scores. Mean FSIQ was 114.7 ± 15.8 for affected participants. No case of mental retardation or borderline intellectual functioning was found.
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L. CADAVID-CELIS, L. MADRIGAL, M. ARCOS-BURGOS, & F. LOPERA. Finding of the Largest Common Pedigree of Alzheimer Disease Families.
Alzheimer's disease is a neurodegenerative disorder characterized by the progressive deterioration of memory and other cognoscitive functions. In the state of Antioquia (Colombia), 26 large families have been identified with early onset Alzheimer's disease (EOFAD) (E280A-PS1 mutation). All affected patients presented the same phenotype and the same mutation. They are from the same geographical region and they have a common last name. To each pedigree has been assigned a code, according to the order that they were found: C1 to C26. The genealogies of some of them have been reconstructed (C1 to C13 and C21) and it has been found that they are related. The aim of this research was to identify a common pedigree for affected EOFAD families, and to find the possible common origin and the possible first founder of the E280A-PS1 mutation in the "Paisa" community. To reconstruct these genealogies several strategies were used: interviews with elder healthy individuals of each affected family, inter-

views with genealogists and historians from Antioquia, examination of baptismal, death, and other ecclesiastical records, testament registries, Antioquia history books, and Antioquia genealogical books. A common pedigree for thirteen affected families was found. We concluded that this finding suggests that this population has a common founder ancestor from Spain. Indeed, we have been able to trace it back to the 17th century (~1670).

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Paper Session 16/3:30–5:15 p.m.

ALCOHOL AND DRUGS

M.C. STEKETEE & L.H. WARREN. Utility of the Mattis Dementia Rating Scale in Young Inpatient Adults with Alcohol-Related Dementia.

The Mattis Dementia Rating Scale (DRS) was designed and normed to assess the extent of deficits in 5 specific domains in older adults who demonstrate neurocognitive decline consistent with dementia. However, norms have not been established for younger adults since this level of dementia is relatively rare. In an acute inpatient setting, the DRS has been used with individuals younger than 69 years of age who were psychiatrically hospitalized with persistent and pronounced neurocognitive deficits secondary to alcohol dependence. Participants included 36 individuals with a primary history of alcohol dependence with an average age of 53.7 (SD = 6.8; range 33–63), who had an average education of 8.5 years (SD = 3.3). All participants were seen in the course of clinical evaluation and, for this study, were screened for other CNS disorders, Axis I disorders, mental retardation, and moderate to severe TBI. Results show statistically significant differences between the younger clinical population and the published MOANS norms (Lucas et al., 1998) for a healthy, nondemented 69-year-old population. Thus, the DRS can be a useful tool for assessing young, impaired inpatients with alcohol-related dementia. Additional between groups comparisons were made of younger and older inpatient groups with the MOANS norms for the healthy, nondemented 69-year-old population to understand a predicted trend toward more severe deficits as age and exposure to alcohol increase.

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B.C. SCHWEINSBURG, O.M. ALHASSOON, M. J. TAYLOR, A.D. DAGER, R. GONZALEZ, S.F. TAPERT, T.L. PATTERSON, & I. GRANT. Alcoholic Females Are More Susceptible Than Males to Alcohol Related Brain Injury.

Structural and functional brain investigations have suggested that females may be more susceptible to the deleterious effects of alcohol than men. Magnetic resonance spectroscopy (MRS: PRESS, TE = 35 ms) and a neuropsychological (NP) examination were used to investigate the interactive effects of gender and alcoholism on cognitive function and brain metabolism. We predicted that female alcoholics would perform worse on NP measures and would have lower relative amounts of frontal lobe gray (FGM) and white matter (FWM) *N*-acetylaspartate (NAA: an indicator of neuronal integrity) relative to controls and male alcoholics. Participants were 7 recently detoxified female alcoholics (RDA–F), 18 recently detoxified male alcoholics (RDA–M), 11 nonalcoholic female controls (CON–F), and 13 nonalcoholic male controls (CON–M). Groups were comparable on demographic variables and body mass index, and the alcoholic groups had similar alcohol consumption variables and abstinence. ANOVA revealed a significant gender by alcohol status interaction for level of NAA in FGM; RDA–F had lower NAA compared to FDA–M and controls. For the FWM and NP domain of learning efficiency, main effects of gender and alcohol status were found; females and alcoholics had lower NAA and poorer novel learning. RDA–F performed significantly worse than all groups on the learning tests. Female alcoholics are more susceptible to neuronal injury in gray matter and to poorer performances on learning efficiency tests compared to demographically similar male alcoholics and controls. The female brain may be more vulnerable to alcohol because of differences in hormones, higher blood alcohol levels during drinking, gender-specific polyamine modulation, and other molecular changes.

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C. CAREY, R.K. HEATON, J. RIPPETH, R. GONZALEZ, D. J. MOORE, T. MARCOTTE, M. RIVERA MINDT, M. CHERNER, T. WOLFSON, I. GRANT, & THE HNRC GROUP. Impact of Comorbid Disorders on the Neuropsychological Performance of a Methamphetamine Dependent Sample.

This study investigated the contribution of comorbid psychiatric and developmental disorders to neuropsychological (NP) impairment in a sample of adults with a history of methamphetamine (Meth) dependence (n = 81). A comprehensive NP battery was administered, and demographically corrected T-scores for each test in the battery were obtained. These scores were then converted to a Global Deficit Score (GDS), which reflects the number and severity of impaired performances on the test battery. Using a previously validated cut-off on the GDS, participants were classified as NP impaired or unimpaired. Impairment status served as the dependent variable in a logistic regression model, which included the following independent variables: attention deficit hyperactivity disorder (ADHD), antisocial personality disorder (ASPD), lifetime history of alcohol dependence, lifetime history of other substance dependence (e.g., marijuana, cocaine, opioids), current level of depression (BDI score), history of learning disabilities (LD), and a quantitative measure of lifetime Meth use. Only LD and ASPD were independently associated with NP impairment ($p < .01$). While participants with LD had significantly higher rates of global impairment (56%) than participants without LD (30%), ASPD unexpectedly related to better NP performance; only 17% of participants with ASPD were NP impaired. Groups with and without ASPD were comparable on Meth use variables, while participants with LD began using Meth at an earlier age than participants without LD. These preliminary results suggest that comorbid disorders, particularly LD and ASPD, may be important predictors of NP impairment in Meth dependent individuals.

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R. GONZALEZ, C. CAREY, D. J. MOORE, B.C. SCHWEINSBURG, J. RIPPETH, R.K. HEATON, M. CHERNER, I. GRANT, & THE HNRC GROUP. Effects of Cannabis Use on the Cognitive Performance of Methamphetamine Dependent Individuals.

Neuropsychological (NP) performance was compared between 3 groups: (1) subjects with a history of methamphetamine dependence (Meth) and history of cannabis abuse/dependence (M+C+, n = 47); (2) Meth dependent subjects without history of cannabis abuse/dependence (M+C−, n = 25); (3) a control group (M−C−, n = 52). The 3 groups did not differ significantly on ethnicity and age. Statistically significant differences, albeit small, were observed on years of education and sex. The 2 M+ groups were comparable in terms of demographics, psychiatric comorbidity, and Meth use. A comprehensive NP battery was administered, and demographically corrected T-scores were obtained for each measure. T-scores on NP tests were averaged within each of 5 ability areas: Verbal Fluency, Learning, Memory/Retention (M/R), Processing Speed/Working Memory, and Motor Skills. Planned orthogonal contrasts were used to specify if NP performance differed (1) between both M+ groups against the M−C− group and (2) between the M+C+ group and the M+C− group. The M+ groups differed from the M−C− group on average T-scores for tests of Learning ($t(71) = -3.20$, $p < .01$) and M/R ($t(71) = -2.33$, $p = .02$). The M+C+ group performed significantly better than the M+C− group on tests of M/R ($t(71) = 2.22$, $p = .03$). Although not significantly different, blind clinical ratings of NP performance showed greater rates of impairment in the M+C− group for all but 1 of the ability areas rated, when compared to the M+C+ group. These preliminary data suggest that

cannabis use may modify the effects of Meth on NP performance by attenuating Meth induced NP impairment. More complex study designs and additional evidence regarding the neuromechanisms of cannabis are necessary to clarify if its role is indeed neuroprotective in this population.
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E. HERBENER, N. RAINS, D. PITRAK, W. WEDDINGTON, G. NUNNALLY, H. NIXON, A. BECHARA, & E. MARTIN. Drug Abuse Increases Vulnerability to Decision-Making Defects in HIV + Subjects.
"Decision-making" (cf., Damasio et al.) refers to the ability to select advantageous behaviors that result in optimal future outcomes. This complex function is mediated by prefrontal-subcortical systems with particular involvement of ventromedial prefrontal cortex. Bechara and colleagues developed a simulated gambling task that successfully captures defects in decision-making observed in patients with lesions of this prefrontal cortical region. Defective gambling task performance is also common among drug abusers, who typically engage and persist in behaviors that have immediate rewards, but disadvantageous long-term consequences. According to Damasio's model, working memory is a critical component of effective decision-making. In a series of studies our group has consistently documented deficits in working memory in HIV+ polydrug users compared to HIV− controls. In the current study we tested the hypothesis that HIV serostatus and drug abuse might exert additive effects on decision-making. We tested a group of 44 HIV+ polydrug abusers (drug of choice typically crack or heroin) and 19 matched HIV− drug abusing controls on the gambling task. Using recently published criteria for drug abusers we found that approximately 50% of our HIV− drug abusers performed the task abnormally, but 80% of our HIV+ drug abusers performed abnormally ($p < .05$). These data support our hypothesis that HIV+ subjects who continue to use drugs show increased risk of decision-making defects, a finding with significant implications for adherence with treatment and continued high-risk sexual and injection practices.
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E.M. MARTIN, E.V. ISYANOV, J.R. O'NEILL, D. McKIRNAN, C. POWERS, & B. HOPE. Working Memory Defects in Circuit Party MDMA Users (Preliminary Study).
MDMA (± 3,4 methylenedioxymethamphetamine, Ecstasy), the club drug of choice, has known neurotoxic properties, with particular affinity for serotonergic neurons. The clinical literature suggests that working memory (WM) is defective in heterosexual rave attendees with a history of MDMA use. We investigated the integrity of WM systems in a group of HIV− seronegative men who have sex with men (MSMs) with a history of MDMA use, compared with a matched group of HIV− MSMs with no MDMA history. Subjects were regular attendees at circuit parties (gay raves) where MDMA use is common. We targeted WM for study because evidence suggests that PFC circuitry mediates working memory processing and is among the brain regions most prominently affected by MDMA. All subjects' toxicology screens were negative for MDMA and none were tested within 48 hours of last MDMA ingestion. All subjects performed a variant of the letter number span task, which requires the subject to hold and mentally manipulate letter-number sequences. We found that subjects with a history of MDMA use showed significant defects in WM performance compared with non-MDMA controls ($p < .05$). There were no significant differences in self-reported levels of depression and anxiety sensitivity between MDMA and non-MDMA users ($p > .05$). These findings indicate that WM defects can be demonstrated using rigorous cognitive neuropsychological methods in a previous unstudied population of MDMA users at high risk for HIV exposure. These findings will be employed in a larger investigation of potential additive effects of HIV serostatus with MDMA use with possible increased risk for neurocognitive complications.
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L. FREEDMAN, B. TEMPLE, & C. BASSEL. MRI and Neurocognitive Findings in Acute Wernicke-Korsakoff Syndrome.
The acute MRI and neurocognitive findings are presented in a 63-year-old, right-handed male diagnosed with Wernicke-Korsakoff's (W-K) encephalopathy. There was a chronic history of alcohol abuse associated with poor nutrition. The patient was admitted to hospital for investigation of confusion, and initial neurologic examination revealed marked confabulation, cognitive confusion, slight ataxic gait, and nystagmus on lateral gaze, bilaterally. Brain CT was normal, apart from indexing alcohol-related atrophy. In contrast, FLAIR (fluid-attenuated inversion recovery) MRI revealed increased signal in the mamillary bodies, mamillothalamic tracts, periaqueductal grey matter, walls of the 3rd ventricle, and both dorsomedial thalamic nuclei. The disturbance in oculomotor motility gradually improved with thiamine treatment, although there remained a profound anterograde amnesia (with confabulation) documented on comprehensive neurocognitive examination. The acute MR results using FLAIR perfectly paralleled the classic anatomical lesion topography of the W-K syndrome. The diagnostic and clinical utility of MRI in W-K syndrome will be discussed, combined with a survey and review of recent research findings in this area.
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Paper Session 17/3:30–5:15 p.m.

REHABILITATION/TREATMENT

S. RASKIN & C. BUCKHEIT. Long-Term Effect of Prospective Memory Training: One Year Follow-Up.
One of the most promising areas of cognitive rehabilitation is the treatment of prospective memory in individuals with traumatic brain injury. Several studies have suggested that rote repetition helps to increase the span of time for which subjects can remember to perform a task (e.g., Raskin & Sohlberg, 1996; Raskin & Buckheit, in press). Improvements have been demonstrated on laboratory tasks and on measures of generalization in everyday life. Preliminary data using EEG and fMRI also suggest that some of these changes may be due to a reorganization of brain regions employed in tasks that require memory for intentions. The current study is a follow-up on 10 subjects with traumatic brain injury. These subjects received treatment for 6 months in a previous study and demonstrated gains in prospective memory (Raskin & Buckheit, in press). These subjects were then retested one year following the end of the treatment protocal. Subjects demonstrated only slight declines in prospective memory performance. Their performance on our laboratory measure of prospective memory remained significantly improved from baseline. Performance on standard neuropsychological tests of attention, time estimation, executive functions, and learning were unchanged from the testing performed at the termination of treatment. Performance on tests of prospective memory in daily life were not significantly different from performance at the termination of treatment and remained significantly improved from baseline performance. These data suggest that gains made in prospective memory performance are long-lasting and provide a significant effect in the daily lives of those treated.
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G. KAY, V. STARBUCK, M. QUIG, & S. COHAN. Cognitive Improvement Following Treatment of AD with Stabilized, Oral NADH.
Background: On the basis of the known biochemical effects of NADH and results of prior clinical studies, we hypothesized that NADH would slow the progressive deterioration and possibly improve cognitive functioning in Alzheimer's disease (AD). *Methods:* Double-blind, placebo-controlled, parallel group pilot study. Following baseline neuropsychological testing, subjects were randomly assigned to receive either NADH (ENADA® 10 mg QD; $n = 1$) or placebo ($n = 10$). Neuropsychological testing was

repeated at 6-weeks and 6-months. The neuropsychological test battery consisted of: MMSE; Mattis Dementia Rating Scale (MDRS); Hopkins Verbal Learning Test (HLVT); Verbal Fluency Test (VF); Fuld Object Memory Test, and CogScreen® Matching to Sample Test (MTS). *Results:* Seventeen subjects completed the study. Groups did not differ with respect to age, months since diagnosis, or on the primary outcome measures (VF & HVLT Discrimination). However, baseline differences between groups were found on MDRS attention and HVLT Sum. After 6 months of treatment, NADH subjects improved and placebo subjects declined on measures of verbal memory (HVLT, $p < .04$). Similarly, improved verbal fluency was found for NADH subjects and decreased fluency was found for placebo subjects at 6-months (VF, $p < .04$). On visual immediate recall, placebo subjects deteriorated in accuracy while NADH subjects showed a modest increase in accuracy (MTS, $p = .02$). Three of 9 NADH subjects improved on measures of verbal fluency and 5 of 9 improved on measures of verbal memory. *Conclusions:* AD patients receiving NADH showed significant improvement on measures of verbal learning, verbal fluency, and immediate visual memory.

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F. HILLARY, M. SCHULTHEIS, B. CHALLIS, J. ESPOSITO, & J. DeLUCA. Spacing of Repetitions Improves Learning and Memory After Moderate and Severe TBI.

Extensive research has determined that in healthy individuals learning information is significantly improved when trials are distributed over time (spaced presentation) compared to consecutive learning trials (massed presentation). This "spacing effect" has been shown to enhance learning for verbal and nonverbal material across different age groups and in different memory paradigms (e.g., recognition, recall). The purpose of this study was to examine whether the performance of individuals with moderate and severe TBI (traumatic brain injury) is improved using a spacing procedure. Participants with TBI ($n = 115$) were presented a list of 115 words that were presented either once (single condition), twice consecutively (massed condition), or twice with 5–7 words between presentations (spaced condition). Participants were not asked to "memorize" words during presentation, instead study participants were required to rank each word from 1 to 10 (1 = low, 10 = high) according to their familiarity with the word. Word list learning was measured with a free recall test immediately following list presentation and with free recall and recognition measurements after a 30-minute delay. Based on Wilcoxin sign ranks, participants recalled and recognized significantly more spaced words than massed words [$z(13) = 2.4$, $p < .05$; $z(13) = 2.2$, $p < .05$; respectively]. In fact, of the 15 participants, only 1 recognized more massed than spaced words. These results strongly indicate that the spacing of repetitions improves learning and memory in individuals who have sustained moderate to severe TBI. Implications for rehabilitation will be discussed.

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W. HIGH, T. ROEBUCK, A. SANDER, M. STRUCHEN, T. ATCHISON, & M. SHERER. Acute *versus* Chronic Admission to Post-Acute Rehabilitation: Impact on Functional Outcome.

As inpatient rehabilitation stay following traumatic brain injury (TBI) has decreased in the last decade, postacute rehabilitation programs (PRP) have become more important for independence and vocational reentry. Research on outcome after PRP has generally shown favorable results, with functional gains maintained several years following discharge. However, most studies have not controlled for the impact of spontaneous recovery. The current study investigated functional outcome following PRP in 3 groups of TBI patients that differed in length of time between injury and admission to PRP, and presumably in magnitude of spontaneous recovery. The first group entered PRP within 6 months of injury ($n = 104$); the second group, between 6 and 12 months ($n = 23$); and the third group, greater than 12 months ($n = 26$). Repeated measures analyses were used to assess groups at admission, discharge, and 1.5 years following discharge on the Disability Rating Scale, Community Integration Scale, and Supervision Rating Scale. All groups showed improvements between admission and discharge on measures of overall functioning, independence, and productivity, which were maintained at follow-up. The 6–12 month and > 12 month groups did not improve from admit to discharge on social and home integration scales, although gains in home integration were seen at follow-up in the 6–12 month group. These results support earlier findings that PRP assist in increasing independence and vocational reentry following TBI and that these gains are maintained at follow-up. Importantly, evidence of gains in patients who entered PRP at > 12 months postinjury indicate that such gains are not due to spontaneous recovery alone.

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D. HOOFIEN, A. WASSERMAN, J. MIMRAN, H. PALMER, & G. WINOCUR. The Relative Efficacy of Attention and Memory Training in Patients with TBI.

Deficits of attention and memory are among the most conspicuous cognitive outcomes of TBI. Various efforts toward the neuropsychological rehabilitation of these 2 domains have been reported in the literature. While there are numerous indications of positive results, most studies failed to control for the order of treatment delivery, nor did they adequately assess consecutive and additive effects of treatment. The present study addressed these issues empirically in a between groups, quasi-experimental factorial design. The subjects were 26 patients with severe TBI who participated in an intensive outpatient neuropsychological rehabilitation program. Two cognitive treatment protocols were administered to 2 arbitrarily assigned experimental groups: Protocol 1 = attention first (4 months), memory second (4 months) and Protocol 2 = the reverse order. Half of the participants received the first protocol; the other half, the second protocol. A battery of repeatable tests of memory, attention, and cognition was administered before the treatment, after 4 months (at the interchange of the treatment protocols), at the end of the program (at 8 months), and 6 months later. Preliminary results of this study indicate two trends: (a) Significant improvement in attention and memory performance in the 2 experimental groups, which was gained during the first 4 months and was still present 6 months after the program's termination (main effect of time). (b) An interaction effect of time by domain, wherein the attention-memory group (Protocol 1) achieved greater improvement than the memory-attention group (Protocol 2). The results highlight the differential importance of attention and memory training in cognitive rehabilitation programs and underscore the benefits of early attention training.

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R.L. TATE, A. PFAFF, & L. JURJEVIC. Posttraumatic Amnesia as a Guide to Commencing Therapy in Patients Who Are Slow to Recover from Traumatic Brain Injury.

On admission to rehabilitation, many patients with traumatic brain injury are in posttraumatic amnesia (PTA). Current practice recommends monitoring recovery of and emergence from PTA as a guide to clinical decision-making, such as when to commence formal therapies. Yet recent reports have questioned the capacity of standard measures of PTA to accurately determine the precise end point of PTA. This study examined recovery profiles of components of PTA in people with prolonged PTA, focusing on disorientation, amnesia, agitated behavior and impaired attention. Fifteen patients (mean age 34 years) from a consecutive series of 68 admissions to a rehabilitation unit had PTA durations in excess of 50 days (mean PTA 112.3 days; $SD = 67.15$). Two clusters of functions recovered at significantly different times posttrauma: agitated behavior, impaired attention, and recognition memory (between days 67–70) *versus* temporal orientation and free recall memory (days 100 and 104 posttrauma); orientation to place adopted an intermediate position (day 82 posttrauma), closer to the first than the second grouping. At an individual level, however, agitated behavior was not always the first to recover and in three patients (20%) it was the last of the six components to resolve. For the majority (73%),

recognition memory recovered much earlier than orientation. These results suggest that rehabilitation therapies could commence well before the patient has fully emerged from PTA (10 versus 16 weeks posttrauma in this sample). A useful clinical guide is when the patient is able to sustain attention, agitated behavior has settled, and s/he can encode new information.
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D.L. KENDALL, T. CONWAY, J. ROSENBEK, & L. J. GONZALEZ-ROTHI. Rehabilitation of Phonological Processing in Chronic Aphasia.
Rehabilitation interventions for language deficits following stroke typically focus on the acute and subacute phases with little attention to the chronic state. Partial functional recovery following stroke is expected as a result of spontaneously generated compensatory mechanisms, however most believe that recovery of language is more resistant to such spontaneous change as well as to the effects of rehabilitation. This study showed dramatic improvement in language function as the result of a theoretically motivated rehabilitation program focused on phonological processing which is an underlying mechanism of language. In the context of a repeated measures multiple baseline design, 3 subjects received intensive behavioral language rehabilitation. Each subject had chronic nonfluent aphasia, alexia, agraphia, anomia, and apraxia of speech (3 years to 54 years post stroke) and received between 2–3 hours of therapy/day, 4–5 days/week for 6 months. A battery of language, neuropsychological, central auditory processing, and psychosocial evaluations were administered prior to and following treatment. Improvement was noted in measures of auditory processing, verbal fluency, phoneme perception, auditory perception/comprehension, word repetition, and reading comprehension. This study demonstrates marked improvement generalized across language domains as a result of intensive phonological therapy in chronic aphasia. The results from this investigation are discussed in terms of neural reorganization following treatment and the role of phonological processing underlying normal language function and rehabilitation.
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Symposium 13/3:30–5:15 p.m.

EDUCATIONAL EFFECTS ON COGNITIVE FUNCTIONS: COGNITIVE RESERVE, COMPENSATION OR TESTING BIAS?

Organizer: Feggy Ostrosky-Solis
Chair: Alexandre Castro-Caldas

F. OSTROSKY-SOLIS, A. CASTRO-CALDAS, & Y. STERN. Educational Effects on Cognitive Functions: Cognitive Reserve, Compensation or Testing Bias?
Several studies have postulated that a low level of educational and occupational attainment is associated with increased risk of developing dementia. This is hypothesized to be the result of differences in mental stimulation, lifestyle, or brain development. These effects have been described as cognitive and or brain reserve. However, other studies suggest that differences associated with reserve could also be due to test bias, because individuals with lower educational and occupational attainment perform worse on the neuropsychological tests used to diagnose dementia. The association of high education with late age of onset of dementia have also been considered as evidence of cognitive reserve. However, other studies have shown an early detection of symptoms on the highly educated. It is also important to dissociate the relative contribution of education to brain reserve, e.g., a greater number of synapses *versus* cognitive reserve. The latter may take the form of compensatory strategies to cope with the effects of brain damage. This symposium analyzes the impact of culture on neuropsychological test performance. Cultural differences in cognitive abilities are reviewed. Clinical, epidemiological, and cognitive neuroimaging studies of normal and demented subjects will be presented. It is proposed that understanding how variables potentially affect (and confound) test performance may be more important than simply developing norms that adjust for these variables. Suggestions for further research will be presented.
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Y. STERN. What Is Cognitive Reserve?
The idea of reserve against brain damage stems from the repeated observation that there does not appear to be a direct relationship between the degree of brain pathology or brain damage and the clinical manifestation of that damage. One convenient subdivision of reserve models revolves around whether they envision reserve as a passive process, such as in brain reserve or threshold, or see the brain as actively attempting to cope with or compensate for pathology, as in cognitive reserve. Cognitive reserve may be based on more efficient utilization of brain networks or on enhanced ability to recruit alternate brain networks as needed. When studying reserve, careful attention must be given to potential confounds. For example, typical correlates of reserve include IQ and education, both of which can directly affect test performance in the absence of reserve. Epidemiologic and imaging approaches to these issues will be described.
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E. MATUTE. Neuropsychological Test Performance on Healthy Illiterate Children.
A large number of neuropsychological studies on the adult population have reported that performance varies according to subject's educational level (expressed in number of completed school grades). Other studies have emphasized the unique effect of illiteracy. In this symposium we start from a discussion of existing empirical evidence about the adult population according to which (a) literacy promotes the development of different cognitive skills, and (b) literacy seems to change cognition-related cerebral organization. However, we have to take into account the fact that the process of becoming literate starts in early childhood (between 6 and 9 years of age), whereas the studies mentioned above are performed on adults (over 20 years old). It may safely be assumed that in the intervening years cognitive adjustment processes and compensatory strategies must be present in illiterate subjects so as to function within their environment. We will discuss evidence suggesting that for the child population the literacy effect is already evident in the performance of neuropsychological tests. Furthermore, this effect seems to be related to the time when the ability assessed is learned: in early acquisition skills, perceptual and memory skills antedating reading instruction, it does not seem to be present. The most relevant effect is observed in arithmetic and metalinguistic skills.
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M. ROSSELLI & A. ARDILA. The Influence of Education and Culture in Nonverbal Neuropsychological Measurements.
For many years clinical neuropsychologists considered visuospatial tests and nonverbal tests culturally and educationally fair or at least more fair than verbal tests. This study reviews the cross-cultural differences in perceptual ability tasks and analyzes the impact of education and culture on nonverbal neuropsychological measurements. Several studies have demonstrated a strong association between educational level and performance in common nonverbal neuropsychological tests [for example, the Rey-Osterrieth Complex Figure Test, the Wisconsin Card Sorting Test, and performance IQ subtests]. Extremely low scores in current neuropsychological tests such as Block Design using a time limit, drawing-a-map, and

copy and recall of the Rey-Osterrieth Complex Figure have been observed in illiterate people and in Amazonian Indians compared to well-educated groups. In contrast, in some neuropsychological tests performance was virtually perfect, such as the Recognition of Overlapped Figures and Ideomotor Praxis Ability. Different cultural explanations are given to account for this variability. Arguments against the use of some current neuropsychological nonverbal instruments, procedures, and norms to assess these cultural groups are presented.
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M. GUERREIRO & A. CASTRO-CALDAS. Cultural Level and the Characteristics of Alzheimer's Disease: Baseline Evaluations and Progression.
Three hundred and thirty-one patients with probable Alzheimer's disease (AD) were assessed. They belonged to 4 different cultural levels. Thirty-seven were completely illiterate, 171 had 1–4 years of schooling, 67 had 4–9 years of schooling, and 56 had more than 9 years of schooling. Baseline evaluation showed that in some domains the influence of cultural level was more evident, and that this pattern was constant along the progression of the disease. Less educated subjects have different cognitive strategies to perform the tests compared to higher educated ones. This may reflect the use of different regions of the brain, and therefore, a different pattern of involvement by the pathologic process that has the same topography in all groups of subjects.
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S. MEJÍA, F. LOPERA, M. GIRALDO, D.A. PINEDA, & A. ARDILA. Age of Onset in Familial Alzheimer's Disease: Educational Effects.
Age of onset in familial Alzheimer's disease (AD) shows great variability in the Colombian Sample, which ranges from 32 to 62 years (Lopera et al., 1997). Reserve hypothesis suggests that clinical symptoms of Alzheimer's disease begin earlier in individuals with less education (Katzman, 1993). In a sample of 49 subjects with the E280A mutation of the presenilin-1 gene (PS-1), age of onset was determined based on family members or patient report of first cognitive symptoms manifestations. The sample was divided in 2 groups according to age of onset (early and late) and in 2 groups according to years of education (low and high). Bivariate analyses showed significantly more patients with high education in the early onset group ($\chi^2 = 5.55$, $p = .018$). Logistic regression analyses adjusted for sex showed that the high educational group was more likely to have early age of onset of Alzheimer's disease than late age of onset (OR = 5.8; 95% CI, 1.1 to 30.6, -2 log likelihood = 61.8). Our data provide no evidence of any protective effect of education for age of onset of first cognitive symptoms in Alzheimer's familial disease. Education may have a confounding effect on age of onset making the highly educated more prone to detect cognitive symptoms.
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F. OSTROSKY-SOLIS & A. ARDILA. Age-Related Cognitive Decline: The Complex Effect of Education.
It has been proposed that education provides protection against dementia and that "psychosocial risk factors" (i.e., no or low education) reduce the margin of "intellectural reserve" to a level where a minor level of brain pathology results in a dementia. However, other studies have pointed out that there are different patterns of association between age-related decline and education. In order to further explore these patterns we administered a neuropsychological battery to 806 subjects age 16 to 85 years. Subjects were grouped into 4 educational levels: completely illiterate (no education), 1–4, 5–9, and 10 or more years of education. In some cognitive functions (e.g., copy of a complex figure) the age-related decline was the same in the different educational groups, in other cognitive functions (e.g., verbal memory) the age-related decline was attenuated in well-educated participants; and furthermore, in other cognitive domains (e.g., semantic verbal fluency), the initial advantage of well-educated groups was reduced in later life. We discussed that the protective effect of education is not always observed, but depends upon the specific cognitive ability that is measured, and that the diagnosis of dementia using psychometric procedures penalized low-educated individuals. A minor cognitive decline in illiterates may be extremely deleterious, whereas a similar raw decline in the highly educated may be virtually unnoticed. Testing bias may overestimate the severity of cognitive decline and hence the estimated prevalence of dementia among less educated individuals.
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Symposium 14/3:30–5:15 p.m.

CEREBRAL LOCALIZATION AND FUNCTIONAL OUTCOME: CORRELATIONS BETWEEN BRAIN AND BEHAVIOR IN CHILDREN

Organizer and Chair: Vicki Anderson

V. ANDERSON. Cerebral Localization and Functional Outcome: Correlations Between Brain and Behavior in Children.
Advances in child neuropsychology have led to uncertainty regarding the validity of theories of brain plasticity and vulnerability. It is argued that the young brain has the capacity for functional reorganization, but there is little direct evidence that this occurs, or if it is associated with positive outcome. Neither plasticity nor vulnerability are able to explain the range of outcomes, and thus a number of protective/risk factors have been proposed to account for this variability, including timing, nature and severity of insult, gender, and psychosocial factors. It is argued that these parameters interact to determine where on the plasticity–vulnerability continuum outcome falls. Until recently, direct investigation of these issues was limited. Recent advances in neuroimaging provide an opportunity to examine fine-grained structural and functional data, to visualize cerebral activation patterns, and correlate this with behavioral data. Despite progress, availability of valid, developmentally-appropriate behavioral measures continue to determine the applicability of such research. The 4 papers in this symposium represent examples of research conducted within such a framework. They employ research-based data to explore risk factors for outcome from early brain insult, and illustrate the efficacy of correlating neuroimaging, neuropsychological, and behavioral perspectives. The symposium has 3 general aims: (1) to examine the advantages of combining neuroimaging, neuropsychological, and behavioral data to further knowledge in child neuropsychology; (2) to emphasize the importance of employing developmentally appropriate theory and methodology in this endeavor; and (3) to explore the significance of these techniques for clinical practice and intervention.
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A. WOOD, A. HARVEY, M. WELLARD, M. KEAN, D. ABBOTT, V. ANDERSON, M. SALING, & G. JACKSON. Functional MRI of Expressive Language in Children.
Our understanding of language representation in children derives principally from its anomalies in the face of cerebral insult. Functional neuroimaging offers a means to examine language representation in healthy children. Forty-three children aged 7 to 15 years and 17 adults were recruited through hospital advertisements. Handedness was recorded in all participants and children had neuropsychological assessment of language and other cognitive skills. The activation paradigms used were orthographic lexical retrieval and noun-verb generation. Stimuli were presented visually, against a patterned background. Activation state stimuli alternated with a fixation point during rest over 6 cycles. Eighteen coronal *Epibold* funtional images (GE Echo Speed 1.5 T, single shot gradient EPI)

were acquired. T1 and angiographic images at each functional image location were also obtained. Statistical maps of activation were created using software developed in-house. The distribution of activation was left-lateralized in the majority of participants. Three children showed bilateral activation. The typical sites of activation in both paradigms were left middle and inferior frontal gyri, medial frontal cortex, and posterior temporal lobe. The present study shows that fMRI is viable in MR-naïve children as young as 7. On the basis of activation patterns, different fluency fluency tasks appear to tap the same aspects of the language system. These data provide a unique basis to study language representation in the context of normal and abnormal cerebral development.

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V. ANDERSON, A. HARVEY, D. ABBOTT, D. ANDERSON, M. KEAN, A. PUCE, M. SALING, & G. JACKSON. Functional Magnetic Resonance Imaging (fMRI) in Children: A Tool for Understanding Cerebral Plasticity and Functional Reorganization?

Contrary to "plasticity" theories, outcome from early brain insult is often poor and prognosis unpredictable. A noninvasive means of studying brain plasticity and functional reorganization in children, fMRI, was employed to investigate cerebral localization and lateralization of language activation in 23 children aged 8–18 years, with pre-, peri-, and post-natal left hemisphere lesions including prefrontal cortex. Handedness was recorded in all participants and all had neuropsychological assessment of language and cognitive skills. Activation paradigm used was a phonetically-cued orthographic lexical retrieval task, with blocked design of 6 × (30 s task–30 s rest). Four axial and coronal *Epibold* functional images (GE Echo Speed 1.5 T, single shot gradient EPI) were acquired. T1 and angiographic images at each functional image location were also obtained. Statistical maps of activation were created using software developed in-house. Despite early age at insult, distribution of activation was primarily left-lateralized, suggesting little evidence for language reorganization. With respect to predictors of outcome, results suggested timing of insult and gender had little demonstrable effect on cortical activation patterns, while a history of left-handedness and damage to language cortex was associated with language "reorganization." Better outcome was observed with partial transfer and with focal lesions. Poorest outcome was related to presence of large lesions sustained in early childhood or bilateral damage, involving frontal lobes, regardless of timing.

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R. JACOBS, V. ANDERSON, & A.S. HARVEY. Executive Function in Children Following Focal Cerebral Pathology During Childhood: Comparison of Cognitive and Behavioral Measures.

Traditional measures of executive function (EF) as well as the Behavioral Rating of Executive Function (BRIEF), a questionnaire designed to tap behavioral aspects of executive functions in children, were administered to children with focal cerebral lesions sustained during childhood. Twenty-five children aged 7–15 years, with MRI evidence of a focal lesion involving the prefontal cortex (frontal group), and 15 children with MRI evidence of a focal lesion to posterior brain regions (extra-frontal group), were included in the study. Results from the 2 clinical groups were compared with healthy controls ($n = 30$). Both the frontal and extra-frontal groups exhibited executive impairments on the BRIEF and on cognitive measures in comparison to controls, although there was some mild variability in the pattern of deficits exhibited by the frontal and extra-frontal groups. Within the frontal group, there was a trend toward a greater frequency of problems for children with right-sided lesions. Together, these results suggest that while executive impairments may be a common feature of childhood cerebral injury, specific subdomains of executive function may be more vulnerable depending on the site (frontal *vs.* extra-frontal) of cerebral pathology.

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P. ANDERSON, S. WOOD, & V. ANDERSON. Cognitive Deficits in Phenylketonuria: Dopamine Depletion, White Matter Pathology or Both?

Children with phenylketonuria (PKU) escape serious brain damage when diagnosed by newborn screening and treated throughout childhood. However research indicates that they are at risk of mild cognitive deficits such as executive impairments (Welsh, 1996), perhaps related to reduced dopamine levels in the prefrontal cortex (Diamond, 1996). In addition, neuroimaging studies have demonstrated that children with PKU are likely to exhibit white matter abnormalities (WMA), although this pathology is not thought to be functionally important (Pearson et al., 1990). The study aimed to examine the prevalence and clinical significance of the WMA in children with PKU. Thirty-eight children aged between 5 to 18 years underwent neuropsychological assessment (IQ, attention, memory, executive functions, educational achievement) and magnetic resonance imaging. We found that approximately 82% ($n = 31$) of children exhibited mild to severe WMA in periventricular regions, although in severe cases the pathology also extended into frontal and subcortical regions. The neuropsychological status of children with mild WMA ($n = 16$) did not differ greatly from children without white matter pathology ($n = 7$), but children with severe WMA ($n = 15$) exhibited significant deficits in the areas of processing speed, divided attention, mental flexibility, memory and learning, and mathematics ($p < .05$). These findings indicate that children with PKU are likely to exhibit WMA, which can result in information processing deficits when severe. Therefore, the cognitive impairments associated with PKU may be due to severe WMA and/or dopamine depletion.

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Presidential Address/5:30–6:30 p.m.

THE ILLITERATE BRAIN

Alexandre Castro-Caldas

SATURDAY MORNING, FEBRUARY 16, 2002

Poster Session 7/8:00 a.m.–12:00 p.m.

BRAIN INJURY IN CHILDREN

W. MAUTZ, S. CARPENTIERI, B. SHAPIRO, V. DALTON, R. GELBER, S. SALLAN, & D. WABER. Absence of Progression of Cognitive Sequelae 4 to 7 Years After CRT for ALL.

Cranial irradiation has been associated with increased risk for cognitive late effects in children treated for acute lymphoblastic leukemia (ALL). An important question for families, physicians, and educators is whether these late effects stabilize at some point or continue to evolve years later. We hypothesized that children treated with cranial irradiation therapy (CRT) for ALL would demonstrate continued erosion of cognitive function up to 7 years after diagnosis. Fifteen patients (*M* age at diagnosis = 3 years, 11 months) treated on Dana-Farber Cancer Institute Protocol 91-01 were assessed at 4 and 7 years post diagnosis. Therapy included 1800 cGy CRT, intrathecal chemotherapy, and dexamethasone. Children had been in continuous complete remission since diagnosis. The neuropsychological protocol included subtests from the Wechsler Intelligence Scale for Children–

Third Edition, Wide Range Assessment of Memory and Learning, and Woodcock-Johnson Tests of Achievement–Revised Edition. Of 12 measures, means improved for 8 and declined for 4. Paired *t* tests indicated that the magnitude of change was small (all $p > .10$), with the exception of spelling skill, which improved significantly ($p < .05$). Although these findings should be interpreted with caution because of the small sample size, CRT does not appear to be associated with progressive deterioration of neuropsychological functioning, at least after 4 years post-diagnosis. If confirmed in a larger series of patients, the findings would provide reassurance about the long-term prospects of these children.

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C. PORTER-STEVENS, S. RAZ, M. KRONENBERG, T. HOPKINS, M. LAUTERBACH, F. GUNNING-DIXON, & C. SANDER. Birth-Related Hypoxia and Language Development.

We conducted a study of expressive and receptive language development, measured by the Preschool Language Scale (PLS–3), in early school age children at perinatal hypoxic risk. The latter variable was defined as presence of acidosis, the hallmark of perinatal asphyxia, at birth. The sample included 25 term, and 22 preterm birth children whose initial blood gas, sampled within 3 hs after birth, revealed slight to moderate acidosis (arterial pH 7.1–7.29). Using mixed linear model analyses, we entered prematurity (term *vs.* preterm birth), initial arterial pH (a biochemical index of asphyxia), and Apgar score at 5 minutes (a clinical index of asphyxia), simultaneously with 4 variables on which significant group differences emerged. These "covariates" were SES, time to initial blood gas sampling, highest percent of supplemental oxygen required, and twin birth. The association between arterial pH and the Total Language Score (TLS) was statistically significant [$F(1,38) = 5.78$, $p = .002$], but prematurity and the Apgar scores did not exert a significant statistical effect on the TLS. Initial arterial pH was significantly associated with both receptive and expressive language outcomes [$F(1,38) = 5.58$ and 4.18, $p < .023$, and $p < .048$, for the Auditory Comprehension Scale (ACS) and the Expressive Communication Scale (ECS), respectively]. Interestingly, we also observed a significant relationship between prematurity and the difference score between the ECS and ACS [$F(1,38) = 6.56$, $p = .015$]. Preterm birth children had greater ACS, while term birth children had greater ECS, scores (adjusted difference score $M \pm SE = -5.639 \pm 2.87$ and 5.74 ± 3.41, respectively.

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L. TALL, S. PATEL, & E. KATZ. Cognitive Outcome Comparisons in Two Groups of Pediatric Brain Tumor Survivors Diagnosed in Infancy.

Background: Radiation treatment, along with tumor resection and chemotherapy, has been essential in improving overall pediatric brain tumor survival rates; however, many children are left with neurocognitive sequelae. Brain irradiation is now well established as a major risk factor for neurocognitive impairment with subsequent desire to rely more on chemotherapy. The role of chemotherapy without radiation as a risk factor in this group remains controversial, although many studies indicate it presents relatively minimal risk. While diagnosis at a young age is a risk factor, few studies have examined this predictor in the absence of radiation. We hypothesized that chemotherapy at a very young age, even in the absence of radiation, is a risk factor for poor cognitive outcomes among long-term pediatric brain tumor survivors. *Method:* We compared WISC–III and WRAT–3 outcomes in 2 groups: (a) 10 children who received surgery, radiation, and chemotherapy and (b) 8 children with surgery and chemotherapy only. All 18 were diagnosed during infancy (0 to 36 months) and were at least 5 years post-diagnosis at assessment. The groups were similar in ethnicity, tumor type, tumor location, and presence of seizures. *Results:* Compared to normals, both groups showed impairments in VSIQ, PSIQ, and FSIQ regardless of treatment type. The chemo, without radiation, group obtained generally average academic achievement scores whereas the radiated group showed impairment. Two-way ANOVA found no significant differences between the 2 groups on any of the 3 IQ measures. The WRAT–3 mean scores for the chemo group were higher than that of the radiation group, but did not reach significance except for the reading subtest. Additional findings related to gender effects, with girls performing significantly worse on all IQ scores as well as on WRAT–III Arithmetic. Limitations of this study include small sample size, but it does confirm the need for further investigation with multivariate, prospective analysis to examine the impact of chemotherapy at a very young age, as well as the gender effects on outcomes.

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K. ARMSTRONG, S. MANGEOT, A. COLVIN, K.O. YEATES, & H.G. TAYLOR. Long-Term Executive Deficits in Children with Traumatic Brain Injuries.

The long-term prevalence and correlates of executive dysfunction following childhood traumatic brain injuries (TBI) were examined using data drawn from a prospective, longitudinal study. Participants were assessed approximately 5 years post-injury, and included 34 children with severe TBI, 33 with moderate TBI, and 35 with orthopedic injuries (OI). Parents rated executive functions using the Behavior Rating Inventory of Executive Function (BRIEF). Parents also completed several other measures of parent and family functioning, including the Family Burden of Injury Interview (FBII), Family Assessment Device (FAD), and Brief Symptom Inventory (BSI). Children were administered a neuropsychological test battery that included several purported measures of executive functions. Scores on the BRIEF displayed a significant linear trend across groups, with the largest deficits in executive functions reported in the severe TBI group. BRIEF scores were related consistently across all groups to a neuropsychological test of working memory (i.e., consonant trigrams). BRIEF scores also predicted parent psychological distress and perceived family burden, as measured by the BSI and FBII, in all groups. In contrast, general family functioning as measured by the FAD was related to BRIEF scores only in the TBI groups. The findings suggest that pediatric TBI results in persistent deficits in executive functions that are distressing for all families, but may affect general family functioning only among families of children with TBI. Thus, the acute onset of executive dysfunction associated with pediatric TBI might be more disruptive for families than are executive deficits that are developmental in nature.

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D. BEEBE, M.D. RIS, & E. HOLMES. Location May Not Affect IQ and Adaptive Outcome in Pediatric Cerebellar Tumors.

Two recent studies suggested that pediatric cerebellar tumors result in neuropsychological impairment, even in cases of surgical treatment without radiation or chemotherapy. These studies further suggested that tumor location (vermis *vs.* hemispheric) affects outcome. However, sample sizes have been small (ns = 19 and 26) and referral biases may have affected the results. The present study examines the intellectual and adaptive outcomes of 100 children who underwent surgical resection for low-grade cerebellar astrocytomas as part of national collaborative research projects (CCG 9891/POG 9130). Children were classified based upon tumor location: vermal ($n = 37$), mixed vermal-hemispheric (22), right hemispheric (23), and left hemispheric (18). Data on intellectual ability, academic skills, and adaptive functioning were prospectively gathered within 1 year of surgery, as were medical records of pre-, peri-, and post-surgical medical complications. Despite demographics that would favor positive functioning (82% White, median parent education = 14 years), mean scores were significantly below average on most measures of intellectual, academic, and adaptive outcome (12 of 14 ps $\leq .05$, 7 of 14 ps $\leq .003$, 1-tailed). However, intellectual, academic, and adaptive outcome was not associated with tumor location (13 of 14 ps $> .05$, no $p < .01$), nor were these

variables associated with pre-, peri-, or post-surgical complications (41 of 42 $ps > .05$, no $p < .01$). Thus, despite a large sample size and evidence of impairment, we did not find an association between cerebellar tumor location or complications and intellectual and adaptive outcome. However, definitive conclusions await further large-scale studies involving specialized neuropsychological measures.
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M. DENNIS, M. BARNES, J. JANES, & M. WILKINSON. Inferencing From a Situation Model in Children With Spina Bifida and Hydrocephalus.
Children with spina bifida and hydrocephalus (SBH) have language comprehension difficulties that include problems in making inferences to elaborate the situation described by a text. To explore this problem, we created a paradigm of 20 situations each of which involved 2 premises (The candy is in the bag, The bag is behind the curtain) and 4 inferences (Is the candy behind/in front of the curtain? Is the curtain behind/in front of the candy?). Half of the premises, such as those in the example above, described a uniquely specified situation, and half described an incompletely specified situation about actions or personality (The ant is nicer than the spider, The spider is nicer than the beetle. Is the ant nicer/meaner than the beetle? Is the beetle meaner/nicer than the ant?). Participants were 58 8–17-year-old children and adolescents, 29 with SBH (mean age 12.8 years) and 29 controls (*M* age 12.5 years). Compared to controls, children with SBH had difficulty making inferences even when they remembered premise information; made inferences across formats (forwards, backwards, true, false) in fewer situations; and made fewer inferences about partially specified than about fully specified situations. Within the SBH group, children with upper spinal lesions (level L1 and above) had poorer inferencing, and improved less with age, than those with lower lesions (level L2 and below). The comprehension difficulties of children with SBH include an inability to create, and/or to make inferences from, situation models.
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J. HUBER-OKRAINEC & M. DENNIS. Idiomatic Language Deficits in Children with Spina Bifida and Hydrocephalus.
Children with spina bifida and hydrocephalus (SBH) have language comprehension problems that include difficulty with idioms. Idioms, nonliteral phrases whose meanings are not readily predictable from their literal parts, depend on *literality* (whether the idiom can be interpreted literally), *compositionality* (whether individual words contribute to a nonliteral meaning), and *linguistic context* (whether context supports a figurative meaning). We studied 52 children; 26 with SBH and 26 age- and gender-matched peers to explore how *compositionality*, *literality*, and *linguistic context* influence speed and accuracy of idiom comprehension in children with SBH. Participants heard 48 idioms, either in isolation or with a supportive context, then saw the pictured idiom, figurative or literal. They accepted or rejected the picture for meaning. Participants also saw a 4-choice display for each idiom and chose the best meaning from figurative, literal, lexically-related, and unrelated pictures. Children with SBH were significantly less accurate than peers at comprehending idioms in isolation and made more literal and lexically-related errors. Regardless of context, children with SBH were slower than peers to comprehend idioms and were significantly worse than peers at rejecting the literal meanings of idioms. Children with SBH performed significantly less accurately than controls on decomposable, low literal idioms when presented in context, and non-decomposable, highly literal idioms in isolation. They were slower to interpret decomposable, low literal idioms in isolation. Children with SBH have both speed and accuracy deficits in idiom comprehension and different features of idioms influence comprehension in SBH and control groups.
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C. RONCADIN & S. INWOOD. Beyond Coma Scales: Coding Head Injury Severity From Multiple Medical Variables.
Current practices for rating head injury severity are based almost exclusively on coma scales, however these scales have limited utility with infants and younger children and they are generally poor predictors of outcome. The Abbreviated Injury Scale (AIS) is a universal method of coding anatomic injury that includes an ordinal severity rating, with higher scores indicating more severe injuries. We hypothesized that a combination of physiologic and anatomic ratings might provide a more valid metric of childhood head injury severity. We reviewed 64 medical charts of children with a closed head injury (Mild, $N = 41$; Moderate, $N = 9$; Severe, $N = 14$). The groups did not differ significantly in age at injury. Two physiologic variables (lowest post-resuscitation GCS score and duration of loss of consciousness), and 2 anatomic variables (highest AIS severity score assigned to the head region and total number of AIS codes recorded for the head region) were entered into a cluster analysis with iteration. A distinct pattern among the variables emerged, suggestive of new severity groupings. The majority of cases still fell into the Mild category ($N = 34$; high GCS/low AIS), however, the remaining cases divided into 3 other groups: Moderate-Physiologic ($N = 9$; low GCS/low AIS), Moderate-Anatomic ($N = 14$; high GCS/high AIS), and Severe ($N = 7$; low GCS/high AIS). Multivariable coding systems of this form might provide clinicians and researchers with a severity rating system that better estimates the morbidity of moderate head injuries and that has greater specificity and prognostic value for pediatric head injury.
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C. SKINNER & A. BARDOS. Cognitive, Socioemotional, and Academic Effects of Acquired Brain Injury in Children.
The purpose of this study was to examine the effects of acquired brain injury using the Das-Naglieri Cognitive Assessment System (CAS), the Parent Rating Scale of the Behavior Assessment System for Children (BASC), and the Woodcock-Johnson Tests of Achievement (WJ–R). In particular, this study explored how deficits in planning, attention, simultaneous and successive processing may impact a student with ABI socially, emotionally, and academically. Participants in the study included 27 children and adolescents who had received an acquired brain injury. These injuries occurred less than 1 year to 13 years prior to testing, with a mean of 5.1 years. The sample consisted of 20 subjects with traumatic injuries and 7 subjects with nontraumatic injuries. This sample obtained significantly lower means than the standardization sample on the Planning, Attention, Simultaneous, and Successive scales of the CAS. Additionally, this sample received significantly lower means than the standardization sample on the Broad Reading and Broad Math scales of the WJ–R, and on the Externalizing Composite, Internalizing Composite, and Behavioral Symptoms Index of the BASC. Positive relationships were demonstrated between the CAS and the WJ–R. This study demonstrated the efficacy of the CAS in detecting deficits in planning, attention, successive, and simultaneous processing. Moreover, significant deficits were found in mathematics and reading using the WJ–R. This study also demonstrated the usefulness of the BASC in detecting socioemotional problems. The CAS, WJ–R, and BASC all appear to be useful and valid instruments for examining the cognitive, academic, and socioemotional effects of acquired brain injury.
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S. WARSCHAUSKY, J. KAY, P. CHI, & J. DONDERS. Hierarchical Linear Modeling of CVLT–C Learning Curve Characteristics After Pediatric Traumatic Brain Injury.
California Verbal Learning Test–Children's Version (CVLT–C) indices have been shown to be sensitive to the effects of TBI, including lower general performance and less efficient learning over repetition trials with greater severity of injury (Hoffman et al., 2000; Yeates et al., 1995). In this study, the effects of TBI on the learning process were examined with a

growth curve analysis of CVLT–C raw scores across the 5 learning trials. The independent sample with history of TBI including loss of consciousness was comprised of 86 children seen in 2 sites in consecutive series, ages 6–16, mean 13.1 (3.2) years, 9.7 (18.7) months post-injury, 41.2% severe, 25.8% moderate. The best fit model for verbal learning was with a quadratic rather than a simple linear function. Greater TBI severity was associated with lower rate of acquisition and more gradual deceleration in the rate of acquisition. WISC–III PO and PS indexes, previously shown to be sensitive to severity of TBI (Donders, 1997), were positively correlated with rate of acquisition. Effects of site of focal lesion or presence of diffuse injury on CVLT–C performance were not significant predictors of the rate of acquisition. Girls had a greater rate of acquisition. Results provide evidence that the CVLT–C learning slope is not a simple linear function, as well as further support for specific effects of TBI on verbal learning in the context of relative preservation of verbal functions.

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K. DELANEY, R. GRAY, L. CHARNAS, C. PETERS, S. ABEL, & E. SHAPIRO. Neuropsychological Characteristics of MPS VI With and Without Treatment.

MPS VI (Maroteaux-Lamy syndrome) is a rare genetic disease due to an enzymatic deficiency of arylsulfatase B leading to accumulation of mucopolysaccharides in multiple organs. Clinical manifestations include skeletal, cardiac, pulmonary, hepatic, and corneal abnormalities that lead to dwarfism, progressive disability, and early death. The only effective treatment is hematopoietic stem cell transplant (HSCT). Limited data has been published pertaining to the neuropsychological profile and response to treatment. Case reports have indicated no CNS deterioration, unlike other MPS syndromes, although cognitive compromise has been reported associated with hydrocephalus. In this study, the largest sample reported, 12 patients had baseline neuropsychological testing. Results suggest MDI/IQ is within the normal range (94, $SD = 18$) as is the Vineland (92, $SD = 14$). Two of the 13 children fall within the retarded range (neither had hydrocephalus). Six of 8 had significant motor difficulties on pegboard or the Bayley motor scale. No evidence for language or perceptual difficulties was found. Two children who had low IQ did not have HSCT. Two children were lost to follow-up, 2 died in transplant, and 2 are pending follow-up. Of the 6 children followed post-HSCT, 3 lost more than 1 standard deviation of IQ and 3 were stable. Three of the 6 transplanted cases have abnormal results on attentional testing. In summary, 2 of 12 children with MPS VI had below normal IQ, suggesting a higher risk for cognitive impairment. However, most children have normal cognitive function, but motor deficits. Post-HSCT, a risk for attentional abnormality was found.

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M. NORTZ, D. RIS, D. BEEBE, A. BYARS, & M. STEED. A Methodology for Neuropsychological Subtyping in Pediatric Brain Tumor Patients.

The objective of this study was to identify neuropsychological profile subtypes among survivors of pediatric brain tumor and to examine relationships between the subtypes and selected demographic and disease variables. Two neuropsychologists independently and blindly reviewed neuropsychological data in the clinical records of pediatric brain tumor patients ($N = 40$), and impairment ratings across 11 neuropsychological domains were obtained according to an anchored, 7-point scale. Rater agreement was calculated, revealing intraclass correlations in the excellent range (i.e., $\geq .60$) for each neuropsychological domain. Subsequent 2-stage cluster analysis identified 2 reliable profile subtypes ($n = 20$ for each) that differed primarily by level of performance. For external validation, we examined differences between the clusters on demographic and disease variables not included in the clustering process. Later age of diagnosis, history of infratentorial (*vs.* supratentorial) tumors, and history of cranial (*vs.* focal/none) radiotherapy differentiated the low- from the high-functioning subtype ($p < .05$). There were nonsignificant trends ($p < .10$) toward lower level of parental education, history of surgery, and hemiparesis in the low-functioning group. There were no between group differences for time since diagnosis, history of chemotherapy, history of tumor recurrence/progression, or visual deficits. In this study, we demonstrated the reliable use of a neuropsychological rating system across patients who received nonuniform clinical evaluations. Moreover, we demonstrated the utility of cluster analyzing these ratings to derive neuropsychological subtypes that were externally validated against demographic and disease variables. Taken together, this methodology has broad research applications for other clinical populations.

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S.N. MATTSON, A.R. LANG, & K.E. CALARCO. Attentional Focus and Attentional Shift in Children with Heavy Prenatal Alcohol Exposure.

Attentional deficits are considered a hallmark of the teratogenic effects of alcohol. However, characterization of these deficits remains inconclusive. Children with heavy prenatal alcohol exposure and nonexposed controls were evaluated using a paradigm consisting of 3 conditions: visual focus, auditory focus, and auditory-visual shift of attention. For all conditions, visual (blue or yellow squares) and auditory (high or low tones) stimuli were randomly presented at a rate of 450–1450 ms and intertarget intervals (ITI) of 450–30,000 ms. For the focus conditions, participants were required to respond manually to visual or auditory targets. For the shift condition, participants were required to alternate responses between visual targets and auditory targets. Thus, each target served as a cue to disengage and shift attention to the alternate modality. For the visual condition, alcohol-exposed children responded with lower accuracy and slower reaction time for all ITIs. In contrast, for the auditory condition, alcohol-exposed children were less accurate but displayed slower reaction time only on the longest ITI. Finally, for the shift condition, the alcohol-exposed group had slower reaction times on the 2 longest ITIs but had accuracy levels comparable to controls. These data suggest that children with heavy prenatal alcohol exposure have deficits in attention that are not global in nature. Rather, they appear to be able to disengage and shift attentional focus but have difficulty maintaining attention over extended intervals. In addition, deficits in visual attention were pervasive while auditory attention deficits occurred only when ITIs were long (>10 s).

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T.M. ROEBUCK & S.N. MATTSON. Learning in Children with Prenatal Alcohol Exposure: Does an Implicit Strategy Help?

Learning and memory deficits are commonly reported in children with heavy prenatal alcohol exposure. Evidence from the California Verbal Learning Test–Children's Version (CVLT–C) indicates that although learning is impaired in these children, retention for learned information is spared. To further understand learning acquisition in these children, we compared the performance of 35 alcohol-exposed children (ALC) and 34 normally developed children (CON) on the CVLT–C and the verbal learning subtest from the Wide Range Assessment of Memory and Learning (WRAML). To equate the tasks, only the first 4 learning trials from the CVLT–C were examined, and all data were converted to percentages. Overall, ALC children learned less information than CON children and both groups performed relatively better on the CVLT–C than the WRAML. However, CON children's learning curves were similar for the 2 tests while ALC children displayed different rates of learning across the 2 tests. On the CVLT–C, the ALC children learned most new information within the first 2 trials and appeared to reach a plateau quickly. The groups retained a similar percentage of information after a short delay on the CVLT–C. In contrast, ALC children forgot more learned information than CON children on the WRAML, a test that does not have an implicit semantic strategy. Interestingly, ALC children did not differ from CON children on CVLT–C semantic clustering scores, suggesting that the use of

an implicit strategy may have positively affected their ability to learn and retain new verbal information.
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S. GUGER, B. SPIEGLER, & B. MANSBRIDGE. CNS Germinoma in Childhood—Two Case Studies.
CNS germionomas usually arise in the pineal or suprasellar region of the brain and account for less than 1% of all newly diagnosed pediatric brain tumors. Hormonal difficulties more often accompany germinomas in the suprasellar region, while hydrocephalus, headaches, and visual abnormalities are common in both locations. We report 2 right-handed patients treated for CNS germinoma who are clinically and theoretically interesting because of changes in memory and behavior. Patient 1 is a 15-year-old male seen 9 months after diagnosis of a pineal germinoma treated with biopsy, chemotherapy, and craniospinal radiation. Patient 2 is a 9-year-old female seen 12 months after diagnosis of a suprasellar germinoma treated with surgery, chemotherapy, and craniospinal radiation. Both patients demonstrated intact verbal and nonverbal intelligence, academic skills, visual-spatial processing, and problem solving. In the absence of general intellectual deficits, they showed fluctuations of sustained attention and concentration, and significant impairment of new learning, particularly in the verbal modality. While the neurocognitive profiles were similar, only the patient with the suprasellar tumor exhibited behavioral dysregulation, emotional lability, and significant weight gain. These features are common in patients with craniopharyngioma, another tumor of the suprasellar region (Spiegler & Williams, 2000). Central brain tumors put children at increased risk for both memory and self-regulatory disorders, depending, in part, on the specific anatomical location.
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M. PRASAD & L. EWING-COBBS. Social Functioning Following Traumatic Brain Injury in Young Children.
Despite the importance of social functioning in outcome following traumatic brain injury (TBI), little is known about social outcome in young children. Social functioning at 1-year following traumatic brain injury was examined in infants and preschoolers using the socialization domain from the Vineland Adaptive Behavior Scales and the child domain from the Parenting Stress Inventory (PSI). The sample was composed of 44 children with inflicted and noninflicted brain injury and 32 normal controls. Children were between the ages of 2 months and 6 years at the time of injury. Parents of children with TBI were interviewed shortly after the injury regarding their child's pre-injury skill level and were asked to complete the PSI about pre-injury behaviors. Analysis of pre-injury scores indicated no significant age at injury differences on the Vineland or PSI, and the TBI groups were not significantly different from the normal controls. However, children with inflicted TBI scored significantly lower on the pre-injury Vineland socialization domain. At 1-year post-injury, there was a significant age at injury $\times$ group $\times$ time interaction on several indices. Analysis of the interactions indicated that older children with TBI had less favorable scores on the socialization domain of the Vineland as well as increased demandingness and poor adaptability on the PSI. These findings suggest that as young children with brain injury mature, more deficits in social and behavioral functioning are identified.
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S. CHRIST, D. WHITE, & M. DEBAUN. Inhibitory Control in Children with Sickle Cell Disease.
Sickle cell disease (SCD) affects approximately 1 in 400 African Americans and is often associated with brain compromise. Magnetic resonance angiography (MRA) has identified cerebral blood flow abnormalities (e.g., associated with moyamoya), and magnetic resonance imaging (MRI) has identified cerebral infarcts in approximately 20% of children with SCD. Research with children with SCD-related infarcts has revealed impairments across a range of neuropsychological abilities. Little research, however, has been conducted to investigate cognition in children with SCD who have no evidence of cerebral infarct on MRI. We compared the inhibitory control ability of 30 such children with that of 42 healthy control children. Children were asked to depress right or left response buttons as rapidly as possible following the appearance of targets on the right or left of a computer monitor. On half of the trials children were asked to respond by depressing the button corresponding with the target (no-inhibition condition); for the remaining trials children were asked to inhibit this relatively prepotent same-sided response and instead depress the opposite button (inhibition condition). ANOVA revealed a greater increase in both response speed and error rate from the no-inhibition to the inhibition condition for the SCD group compared with the control group. These results suggest the presence of impairments in inhibitory control in children with SCD who have no evidence of cerebral infarct. Thus, the neuropsychological effects of SCD on the developing brain appear to extend to children who have not had a major neurological event such as MRI-verified cerebral infarct.
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E. BRANDLING-BENNETT, D. WHITE, S. CHRIST, M. ARMSTRONG, & M. DEBAUN. Learning and Memory in Children with Frontal Stroke Related to Sickle Cell Disease.
Cerebral infarct occurs in approximately 20% of children with sickle cell disease (SCD). The majority of infarcts affect frontal brain regions, possibly disrupting strategic aspects of learning and memory. The California Verbal Learning Test–Children's Version (CVLT–C) and Digit Span forward and backward were used to compare learning and memory in 2 groups of children with SCD: (1) 21 Control children without evidence of infarct on MRI and (2) 10 children with MRI-verified Infarct affecting frontal cortex. Age ranged from 8 to 17 years for both groups, with a mean of 13 years. Estimated verbal IQs for Control and Infarct groups were 90 and 83, respectively. There were no significant differences in age or verbal IQ. On the CVLT–C, the Infarct group performed significantly poorer in learning over repeated trials. Although a comparable number of words was recalled on Trial 1, by Trial 5 the Infarct group recalled fewer words. Short- and long-delay free-recall was also poorer for the Infarct group, although recognition was intact. On Digit Span, the Control and Infarct groups performed similarly in the forward condition; in the backward condition, however, the Infarct group recalled significantly fewer digits. This pattern of results suggests that SCD-related frontal infarct disrupts strategic processes that facilitate learning and memory. Intact recognition and simple span performance, accompanied by impaired free-recall and working memory (i.e., short-term recall requiring the manipulation of information) support this hypothesis and are consistent with damage to the frontal cortex.
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K. O'TOOLE & K. NIELSEN. Pediatric Right Hemisphere Arteriovenous Malformation: Cognitive and Behavioral Outcomes.
Little information exists on neuropsychological manifestations and follow-up of children with arteriovenous malformations (AVM). The cause of AVM is unknown although clotting of a blood vessel during prenatal development has been proposed. Our previous study of 3 children with AVM in 3 different brain locations (INS, Chicago, 2001), found that cognitive deficits were location specific. This current study follows 3 boys with right hemisphere AVM evaluated at discharge from a day rehabilitation program after treatment. Participant 1 (age 11) had elective resection

of a right frontal AVM noted on evaluation for febrile seizures. Participant 2 (age 15) had preresection embolizaton and resection of a right middle cerebral artery AVM with hemorrhage near the genu of the internal capsule after presenting with headache and acute onset of left hemiparesis. Participant 3 (age 13) had resection of 3 microAVMs and large right parietal hemorrhage with mass effect after presenting with spontaneous left hemiparesis and generalized seizures. All 3 participants previously received A and B grades in regular classes; participant 3 received remedial help in reading. Academic functioning was preserved in all participants. All had neuropsychological deficits associated with the right hemisphere. For example, participants 1 and 2 had deficient nonverbal planning and organization. Participants 2 and 3, who had significant nondominant side hemiparesis, had deficient copying skills and low average constructional skills. All 3 participants had variable nonverbal learning and memory (deficient to average), depending on the task. All 3 participants had emotional lability and outbursts interfering with functioning. Further studies need to assess the relative roles of AVM location and hemorrhage in developmental outcome.

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E.M. JANSIEWICZ & M.L. GRANT. Attention and Executive Functions of Children With Classical and Atypical Phenylketonuria and Benign Hyperphenylalanemia.

A set of neuropsychological abnormalities (e.g., motor abilities, reaction time, visual-spatial skills, attention, and executive functions) has been reported in individuals with PKU, even with early dietary treatment. While the impact of phenylalanine (phe) level over the lifespan has been fairly well-examined, the impact of the phe level at birth has been relatively unstudied to date. In order to examine the hypothesis that phe level at birth would be correlated with attention and executive functions measured later in life, we assessed these skills in 4 groups of children: Classical PKU ($n = 7$), Atypical PKU ($n = 5$), Benign Hyperphenyalaninemia (Hyperphe, $n = 7$), and a healthy control group ($n = 7$). Groups were comparable in terms of age, SES, estimated IQ, and lifespan phe levels. ANOVAs and Bonferroni *post hoc t*-tests did not reveal any significant differences across groups on neurocognitive measures. However, a significant negative correlation was found across groups between mean lifetime phe levels and performance on the Trail Making Test B ($r = -.57$, $p < .03$). Unexpectedly, significant positive correlations were found across groups between percent correct scores on the Loong CPT and phe levels at birth ($r = .50$, $p < .03$) and 2 years prior to testing ($r = .48$, $p < .04$). The current overall results suggest that despite differences in phe level at birth, children with Classical and Atypical PKU who have had consistently well-maintained phe levels do not differ from each other or from children without PKU on measures of intelligence, attention, or executive functions.

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A. DOWNIE, V. FRISK, & L. JAKOBSON. Periventricular Brain Injury and Math Difficulties in ELBW Children.

Children who were born at extremely-low-birthweight (ELBW: birthweight < 1000 grams) are at increased risk to experience math difficulties at school-age. We investigated: (1) the association between the presence and the severity of periventricular brain injury (PVBI) and math ability in ELBW children (M age = 11 years); and (2) the underlying socioeconomic and cognitive factors that might account for these math difficulties. Thirty-nine ELBW children (No PVBI, $n = 11$; Mild PVBI, $n = 18$, and Severe PVBI, $n = 10$) and 14 children born at full-term completed tests of mathematical reasoning and computations. The results indicate that ELBW children without PVBI perform as well as full-term children on both tests. In contrast, ELBW children with mild and severe PVBI achieve significantly lower scores on both math tests than do full-term children. ELBW children with severe PVBI also achieve significantly lower scores than ELBW children without PVBI on mathematical computations. Regression analyses assessed the contribution of maternal education level, working memory, visual-spatial analysis, and vocabulary in predicting math reasoning and math computational skill. These analyses indicate that working memory (22.1%), and vocabulary (16.1%) account for a significant amount of variance in mathematical reasoning performance. Working memory (33%), visual-spatial analysis (17%), and vocabulary (8%) account for a significant proportion of variance in mathematical calculation performance. These findings indicate that PVBI affects the development of math skills. Further, the same factors known to predict math difficulties in full-term children appear to contribute to math impairments in ELBW children.

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A.T. ZABEL, M. VERDA, S. KINSMAN, & M.E. MAHONE. Parent and Self-Report Behavior Rating Inventory of Executive Function (BRIEF) in Adolescents with Myelomeningocele.

Recent investigations have highlighted executive function (EF) deficits in children with myelomeningocele (MM; Fletcher et al., 1996). In the medical setting, there is a need to efficiently obtain information to assist with clinical management of these children; however, broad-band behavior rating scales may not adequately capture the EF domain. As part of a multidisciplinary medical clinic, parent and self-report ratings were obtained for 17 adolescents with MM using the Behavior Assessment System for Children (BASC, Reynolds & Kamphaus, 1992), and the Behavior Rating Inventory of Executive Function (BRIEF) Parent (Gioia et al., 2000) and Self-Report (Guy et al., 1998) forms. Among parent ratings, the BRIEF Global Executive Composite ($M = 65.2$), was significantly higher ($p < .01$) than the BASC Behavior Symptom Index ($M = 57.2$). Mean scores from 3 of the 8 BRIEF scales were clinically elevated, while all of the standard scores from the BASC scales were within normal limits. The BRIEF Metacognition Index mean (67.9) was significantly higher ($p < .05$) than the Behavioral Regulation Index (60.4), with Working Memory, Initiation, and Plan/Organize Scales identified as greatest areas of parent concern. Self-report ratings on all BASC scales were within normal limits. There were moderate correlations (0.4–0.6), between raw score means of corresponding Parent/Self-Report BRIEF scales for all scales except Inhibit and Shift. BRIEF Parent and Self-Report forms capture salient EF deficits in individuals with MM presenting for medical treatment, and are particularly useful in efficiently identifying needs for direct intervention that would not be predicted by IQ or emotional functioning alone.

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E. VRIEZEN & S. PIGOTT. Correlation of the BRIEF with Executive Function Tests in Brain-Damaged Children.

The Behavior Rating Inventory of Executive Function (BRIEF) assesses a parent's observations of behaviors believed to be associated with executive function in children in the home environment. The current investigation examines the relationship between a parent's report of executive function at home and the child's performance on individually-administered neuropsychological tests of executive function. Thirty-seven children, aged 6 to 15, with known or suspected brain damage (traumatic brain injury, brain tumors or abscesses, cerebrovascular abnormalities, and treatment for acute lymphoblastic leukemia), participated in a neuropsychological assessment that included the WISC–III as well as several tests of executive function (FAS, Animals/Foods, Trails B, Wisconsin Card Sorting Test) and a parent completed a BRIEF. Several measures from the BRIEF correlated with Verbal IQ (Metacognition Index, Global Executive Composite, Shift, Working Memory, Plan/Organize Scales; r's range from .35 to .51, $p < .04$), and with Full Scale IQ (Initiate, Plan/Organize, and Monitor Scales; r's range from .33 to .42, $p < .05$). No significant correlations were observed between the BRIEF and tests assessing executive

functions including verbal fluency (r's $\leq$ .23, n.s.), Trails B (r's $\leq$ .16, n.s.), and the Wisconsin Card Sorting Test (r's $\leq$ .26, n.s.). In summary, there is a modest relationship between a child's intellectual abilities and the parent's report of the child's metacognitive abilities (such as working memory, initiating, planning, organizing, monitoring). The data suggest that different behaviors and abilities are assessed by parent reports of executive function on the BRIEF and individually-administered neuropsychological tests of executive function.

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S. PIGOTT, A. HAFFENDEN, & E. VRIEZEN. Performance on a Vigilance Test in Children with Traumatic Brain Injury.

Vriezen and Pigott (2000) recently compared the performance of children with moderate to severe traumatic brain injury (SBI) to children with mild traumatic brain injury (MBI) on a computerized test of vigilance (Conners' Continuous Performance Test). This task requires that subjects press a key each time a target letter appears on the screen and suppress responding when the letter "X" appears. Letters appear randomly and the interstimulus interval (ISI) between letters ranges from 1 to 4 seconds. Vriezen and Pigott (2000) found that children with SBI were more inattentive and variable than children with MBI. The purpose of the current investigation was to further define the nature of this impairment. The performance of 29 children who had sustained a SBI and 14 children who had sustained a MBI was examined for each ISI over the 6 successive time blocks that comprise the 14-minute test. There was no evidence that the SBI group showed a greater decline in performance than the MBI group over the 14 minutes of this test ($F < 1.52$, $p > .05$ for all measures.) However, although both groups showed similar response times at shorter ISIs, the SBI group was slower in terms of both hit response times ($F = 4.89$, $p < .01$) and commission response times ($F = 3.57$, $p < .05$) at longer ISIs than the MBI group. This suggests that the presentation rate of stimuli may be a critical factor in the ability of children with moderate to severe brain injuries to attend and that more rapid presentation rates may facilitate attention.

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S.A. AHMAD, B.P. ROURKE, & C. DRUMMOND. A Comparison of Older Children and Adults with BPPD and NLD.

The study reported is a cross-sectional comparison of relative neuropsychological assets and deficits for older children and adults with nonverbal learning disabilities (NLD) and basic phonological processing disabilities (BPPD). The sample for this study was comprised of clinic-referred children and adults who had been diagnosed with either NLD or BPPD by an experienced clinical neuropsychologist. A total of 322 older children, 9–15 years of age (241 BPPD and 71 NLD) and 71 adults, 18–60 years of age (39 BPPD and 32 NLD) were selected. The NLD and BPPD groups were compared across the child and adult age ranges on a number of verbal, visual-spatial, motor/psychomotor, tactile-perceptual, and concept-formation/problem-solving measures. Not surprisingly, the comparisons confirmed the pattern of relative neuropsychological assets and deficits as predicted by the NLD and BPPD models for both the child and adult groups. Age-related profiles of neuropsychological functioning for both of these LD subtypes were also examined. A pattern of worsening relative neuropsychological assets and deficits with advancing years was evident for the NLD group; the largest declines were found in the area of problem solving, concept formation, and hypothesis testing. A pattern of generally unchanged neuropsychological assets and deficits with advancing years was evident for the BPPD group. Of particular importance, age-related predictions based upon the NLD and BPPD models were confirmed for both groups. The neuropsychological implications of these findings are discussed.

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K. WILLS, B. MEYER, B. VOIGT, J. PERRAULT, S. BORNE, & THE SECRETIN CLINICAL TRIAL GROUP. Relationships Among Observed and Parent-Reported Measures of Social and Communicative Behaviors in Preschoolers With Severe Autism.

As the baseline pretreatment evaluation for a double-blind, placebo-controlled, multiple dose study of behavioral responses to secretin (RG 1068), 126 children (3 to 6 yrs) with severe autism were assessed with Leiter-R, ADOS, ADI-R, CARS, Vineland, MacArthur, Gilliam, & Ghuman-Folstein measures. The CDI and BASC scales were completed for a subsample. Pilot analyses include results of 14 children from one site of the collaborative study. Data from the full sample of 126 children are being analyzed and will be added as available. Higher ADOS and CARS autism scores (clinic-based direct observation) were associated with *less* hyperactive, impulsive, aggressive, and anxious behavior on BASC parent reports ($r = -.55$ to $-.76$). Impaired social interaction (ADOS) was predicted by parent-interview reports of social impairment (ADI, $r = .51$) and poorer adaptive behavior (BASC, $r = -.55$). Children with more serious developmental delays more frequently showed stereotypes. Parent-reported communication measures (Vineland, MacArthur, ADI, CDI) were strongly associated with one another but did not predict directly observed communicative behavior in the clinic. These findings will assist understanding of individual variation in the phenotype of autism, and can help guide selection of clinical and research measures.

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P. ANDERSON, B. MILES, E. CADESKY, G. DEVEBER, & R. HETHERINGTON. The Effects of Stroke on Constructional Praxis in School-Age Children.

Constructional praxis refers to the ability to utilize information about spatial relationships effectively in making perceptual judgments. It has been found to be impaired in various pediatric populations, such as Turner's syndrome and survivors of acute lymphoblastic leukemia. Some investigations have found specific impairments of constructional praxis as a consequence of left *versus* right hemispheric brain lesions. More specifically, right hemisphere injury has been associated with global processing deficits, while left hemisphere injury has been associated with local processing deficits. In our investigation, the effects of pediatric stroke on constructional praxis utilizing the Rey-Osterrieth Complex Figure (Rey, 1941) were examined in school-aged children (ages 7 to 18 years) with right-hemisphere (RH; $n = 11$) or left-hemisphere (LH; $n = 9$) lesions. Copy and delayed recall productions of the figure were coded using 2 scoring methods (Meyers & Meyers, 1996; Stern et al., 1999). A significant difference between the LH group and the normative sample was observed for the copy condition, suggesting reduced visual perceptual and visuomotor integration skills. Both LH and RH groups produced significantly poorer delayed recall figures, relative to the normative sample, indicating reduced visuospatial recall ability. Significant differences between the RH and LH groups were found for the copy condition only, using both scoring methods. The RH group outperformed the LH group on indices of both global and local processing. These findings are inconsistent with previous accounts of constructional apraxia in pediatric and adult populations.

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M. BALTHAZOR, S. LIGHTBODY, C. WASSON, G. LABAO, D. HEBERT, K. CITRON, M. KORUS, & R. POOL. Functional Status Following Renal Transplantation in Older Children and Adolescent Populations: Neuropsychological Outcome.

This project examined post-transplant functional outcome in 10-to-18-year-old children and adolescents who have had a successful renal transplant for at least 2 years. A primary goal of this study was to describe the neuropsychological and academic functioning of transplant recipients in a more comprehensive manner than has hitherto been described. Two con-

trol groups were included in the study: 24 children with a functioning renal transplant and 24 healthy controls matched for age, gender, and socioeconomic status. The results indicated that the renal patients performed significantly below the level of controls on tests of verbal and nonverbal intellectual ability, higher level language functioning, visual-spatial reasoning, and visual-motor function. On tests of immediate recall, working memory, and verbal list learning, the renal transplant recipients also performed significantly below the performance of control subjects. On measures of academic functioning, the academic achievement of renal transplant patients averaged at least 1 *SD* below the performance of the control subjects. The academic underachievement of renal transplant subjects is not just secondary to extraneous factors (e.g., chronic absenteeism), but rather, can be attributed to underlying neuropsychological deficits. These findings of significant neuropsychological and academic problems following renal transplant are in keeping with our impressions that many of the children seen in the Renal Transplant Follow-up Clinic at the Hospital for Sick Children present with significant cognitive and learning disabilities following transplant. The magnitude and prevalence of these problems are in contrast to the relatively benign outcome findings reported in the existing literature.

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D. MABBOTT & J. SNYDER. Neurocognitive Late Effects of Pediatric Cancer: Attention.

Examining the impact of pediatric cancer on attention is essential because CNS disease and treatment can damage myelin: myelinization is important for developing attentional skills. Most researchers have focused exclusively on higher cognitive functions such as the monitoring of attention. We employ a broader approach, which also includes measures of "online" attentional processes. Three computer-based tasks were used to examine the performance of 14 children with acute lymphoblastic leukemia (ALL) relative to 9 children with malignancies not requiring CNS directed treatment. The groups did not differ in age or short-form estimate of IQ. Four children with brain tumors treated with posterior fossa radiotherapy were included for qualitative comparison. "Online" tasks included covert-orienting (the ability to detect sudden changes in the environment) and visual-search (the ability to search for a particular item presented among task-irrelevant items). Attentional monitoring (the ability to maintain an attentional focus) was tested with the Conners' Continuous Performance Test (CCPT). Although the ALL group did not differ from the comparison group for the "online" attention tasks, they demonstrated significantly more errors of omission on the CCPT. Their performance was also poor relative to the normative sample for the CCPT. Children with brain tumors did poorly on all measures. Frontal networks may mediate attentional monitoring: for children with ALL, chemotherapy may selectively damage these networks (Brouwers et al., 1984). Posterior networks may mediate covert orienting and visual search: for children with brain tumors, damage to myelin in posterior regions may disrupt "online" attention, which may subsequently impair the whole attention system.

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K. LOCKWOOD, T. BELL, & R. COLEGROVE. Academic Achievement in Long-Term Survivors of Pediatric Leukemia.

Academic achievement was examined in 56 child and adolescent survivors of acute lymphoblastic leukemia (ALL). All participants had been randomly assigned to a treatment regimen of central nervous system (CNS) prophylactic chemotherapy alone or chemotherapy accompanied by cranial radiation therapy (CRT). Half ($n = 28$) received 1800 cGy CRT with intrathecal methotrexate (IT–MTX); the other half received IT–MTX without CRT. All participants had been in complete continuous remission for a minimum of 6 years. Participants were administered the Tests of Achievement from the Woodcock Johnson Psychoeducational Battery–Revised. Analysis of cancer treatment effects involved statistical control of age, socioeconomic status, age at diagnosis, and time missed from schooling. The overall sample performed within expected limits for the domains of reading and mathematics but demonstrated statistically low performance on tests of written language relative to grade-standardized data for the normative population. Results suggest that patients who were treated with combination therapy including chemotherapy and cranial irradiation experienced more adverse effects in the academic area of written language than those treated with chemotherapy alone. Analysis also revealed that children treated with CRT in early childhood (younger than 54 months of age) experienced a significantly low performance in applied mathematics problems relative to the other participant groups. Early irradiation was also associated with minor deficits in basic word decoding. Findings from this study suggest that prophylactic CNS treatment of childhood ALL may impede achievement in some academic domains during the late-effects period. This study supports previous findings of long-term academic sequelae in patients treated for leukemia. Careful monitoring of academic progress is indicated for long-term survivors of childhood leukemia, particularly those treated with cranial irradiation during early childhood.

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Poster Session 7/8:00 a.m.–12:00 p.m.

CHILD DEVELOPMENT

M.B. RALSTON, D.R. FUERST, & B.P. ROURKE. Comparison of the Psychosocial Typology of Children with Below Average IQ to That of Children with Learning Disabilities.

Reliable subtypes of psychosocial dimensions have been delineated in children with learning disabilities (LD) using the Personality Inventory for Children (PIC; Wirt, Lachar, Klinedinst, & Seat, 1977, PIC–R; Wirt et al., 1984). However, children with learning problems who score below average on standardized psychometric tests of intelligence are usually excluded from these studies; therefore, previous research results cannot be generalized to include them. Using the application of both Q-factor analysis and profile-matching, this study examines the psychosocial typology generated from selected PIC scores of children with below average IQ (BAIQ). The results suggest that the psychosocial dimensions of children with BAIQ are quite similar to those of children with LD in a general sense. Many of the same subtypes were derived, and the proportions of children displaying normal, mild, and severe levels of psychopathology were not significantly different from those of children with LD. There were some minor differences, however. For example, children with BAIQ exhibited a greater tendency to display psychopathology with internalizing features such as anxiety and depression. Consistent with previous research involving children with LD, there were no changes in either type or severity of psychopathology with advancing years. Also of interest, there was the same tendency in children with BAIQ as is evident in those with LD for Verbal IQ $>$ Performance IQ to be associated with more severe levels of psychopathology than is the case for those with Verbal IQ $<$ Performance IQ.

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G.C. HENAO, N.H. LONDOÑO, & D.A. PINEDA. Personality Traits in Children with Low Academic Achievement.

A study to search for a basis to explain low academic achievement was conducted with a group of 84 children (44 girls, 40 boys all with low academic achievement). Personality is measured following Cattel's theory. CPQ test was applied, measuring extraversion–introversion variables and also 2 decatypes: anxiety–adjustment and excitability–stubbornness. Comparative analysis, controlling age, and sex variables was made. Lower academic achievement is found in younger children with high anxiety, excitability, and extraversion score. This relates to Eysenck's hypothesis, where low academic achievement is expected in children presenting levels of extraversion–anxiety, due to the fact that these children are described as distractible, with low tolerance to external demands, and high fatig-

ability indices. In conclusion, more influence on academic achievement was observed in those children sharing two personality decatypes: extraversion–anxiety.
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G.C. HENAO, D. PINEDA, G.J. VÉLEZ, C. ARDILA, V. PACHÓN, O. GÓMEZ, & I. CADAVID. Language Profile in School-Aged Children with Low Academic Achievement.
In order to determine the functions and characteristics of semantic language and reading comprehension processes, 84 children (44 girls, 40 boys) between 7 and 12 years of age from Medellin, were selected. A neuropsychological assessment battery was applied to measure I.Q., attention, learning strategies, and language: reading comprehension, inferences, similarities, and verbal fluency. Also a retrospective questionnaire was applied that evaluated the language development process. Children with I.Q. over 80 were selected, and language variables were grouped as fluency, reading comprehension, and reading strategies. Using language development as the dependent variable 3 large groups of children were categorized: slow, normal, and fast. ANOVA comparative analysis showed a significant difference (<0.001) among slow and normal language development groups. The slow language development group present a lower reading comprehension and verbal fluency level. These findings are in accordance with the phonetical conscience theory.
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H. SWAAB, L. DE SONNEVILLE, P. COHEN, & H. VAN ENGELAND. Neuropsychological Profiles, Correspondence to Child Psychiatric Diagnoses.
The question is addressed whether specific neuropsychological dysfunctions show any correspondence with specific behavioral problems or child psychiatric diagnoses. Eight-hundred-forty-eight child psychiatric patients between 7–12 years of age were seen. Boys with diagnoses within the 4 major psychiatric categories (1) attention deficit hyperactivity disorder (ADHD), (2) conduct disorder or oppositional disorder, (3) anxiety disorder or dysthymia, and (4) pervasive developmental disorder were included, as well as 60 normal control boys. All children had IQ scores between 70 and 130. Kaufmann Factor scores of the intelligence profiles (WISC–R) are related to specific behavior problems as reported by teachers and parents. Intelligence profiles are also compared to performance on several information processing tasks. Sustained, focused and divided attention and aspects of executive functioning (several aspects of inhibition and behavioral control) are evaluated for each diagnostic group and are also related to specific dimensions of problem behavior. The overall conclusions are (1) that attention problems, low capacity, and inaccuracy in information processing is very common in child psychiatric patients. (2) Moreover, meaningful and specific correlations are found between severity of some information processing problems and severity of some behavioral problems. Therefore it is suggested that individual assessment of information processing control in clinical practice gives additional and specific information about the severity of the problems and helps to predict outcome of treatment and prognosis in general. It is also shown that screening the intelligence profile of a particular child helps to identify the information processing problems.
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S. ÄYSTÖ & F. BÜCHEL. Attentional Disorders in Relation to Neurocognitive Functions in Mental Retardation.
In a representative sample of persons with mental retardation ($N = 258$; age 2 to 64 years) attentional disorders were evaluated by a clinically oriented attention scale (COA) that in factor analysis gave 4 separate clinical scales: Inattention (INA), Inertia (INER), Impulsivity (IMP), and Hyperactivity (HYP). Selective attention correlated significantly with all the COA scales, the highest correlations with INA ($-.35$ and $-.48$) and lowest with INER ($-.18$ and $-.25$). Sustained attention (vigilance) correlated highly with all the COA subscales (highest with INA, $r = -.39$) except with INER, as was the case for Word recall ($r = -.17$ to $-.43$). Figural memory task ($r = -.24$ to $-.47$) and Nonverbal serial task correlated significantly with the COA subscales ($r = -.17$ to $-.46$). Digit span forward correlated only with INA ($r = -.27$) but Digit span backward correlated significantly also with IMP ($r = -.19$). Neuropsychological disturbances in praxias and receptive functions and agnosias correlated significantly ($r = .19$ to $.55$) with all the COA scales. Very few tasks of expressive and higher cortical functions and academic skills did not correlate with INER and IMP scales, but the correlations were significant for all the other COA scales. The degree of retardation correlated significantly with the COA subscales ($r = -.35$ to $-.48$) but intelligence only with the subscales of INER and INA ($r = -.21$ to $-.25$), WISC/WAIS). Age correlated significantly with the other COA scales than INER ($r = -.17$ to $-.24$) showing the older persons having less attentional disorders. Cross-sectionally, the means for INER and INA remained about the same across the age span, but IMP and HYP scores were elevated during the developmental years, showing the highest peak at the age of 11–12, after which the scores diminished evenly towards the age of 20, and remained about the same until old age. In conclusion, attentional disorders in mental retardation are associated with deficiencies in memory, cognitions, and neuropsychological functions. Attentional disorders seem to vary over the life span.
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S. ÄYSTÖ & K. BARISNIKOV. Characteristics of Attentional Disorders in Mental Retardation.
Characteristics of attentional disorders and their general or specific nature are a dispute in mental retardation. As a part of neuropsychological examination, a clinically oriented attention checklist (COA) was developed to assess attentional disorders in a representative sample of persons with mental retardation ($n = 258$). This 14-item COA scale was factor analytically found to include reliable measures of hyperactivity (HYP), inattention (INA), inertia (INER), and impulsivity (IMP). All these subscales correlated significantly (r from $-.29$ to $-.57$) with the sum score of adaptive behavior (Nihira et al., 1974) demonstrating that better adaption was associated with less attention disorders. Also, the more clinical attention disorders the person had, the more s/he had maladaptive behavior and socioemotional problems. Of the subscales, only INER did not correlate with the sum score of maladaption and with psychosocial problems. In regression analyses, the subscales of INER, INA, and HYP together explained 38% of the sum score of adaptive behavior (independent functioning). Maladaptive behavior and socioemotional problems were best predicted (15%) by the subscale of IMP. Motor disorders were predicted by INER, INA, and IMP in 25%, but not by HYP. The results of the cluster analysis supported the role of inattention as a distinct feature in attentional disorders. All clinical subscales correlated significantly with the degree of retardation and the highest correlations (.53) were with the inhibitory scales (INA + INER). There were no differences in the COA scores according to different etiologies (genetic, other than genetic, nonspecified) or gender. It was concluded that attentional disorders in mental retardation have a strong inhibitory component with inattention being a distinct characteristic. Attentional disorders show direct relation to the degree of retardation and co-occur with maladaptive and socioemotional problems. Also, they seem to be more general than specific to different etiologies.
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R.B. PERNA & A.M. PODRAZA. Phenylketonuria: Performance Variability on Neuropsychological Testing.
Phenylketonuria is a genetic condition that prevents normal use of protein food. It can cause mental retardation and commonly causes depressed

performance IQ's, though verbal IQ's are less often depressed, if controlled early in life through proper diet. This study presents 2 siblings with PKU, a 10-year-old boy (Tim) and his 8-year-old sister (Tina). Both were diagnosed with PKU shortly after birth. His initial level of PKU was 50 and hers 20. Levels between 2 and 6 are optimal. Each completed a neuropsychological battery as follow-up to educational testing and to address behavioral problems. At the time of testing, her PKU level was in the 6 to 10 range and his was in the 10 to 12 range. Each displayed a pattern of diffuse cerebral dysfunction with likely maximal involvement of the right hemisphere, which was consistent with PKU. Both had moderately to severely impaired visuospatial functions, visuomotor integration, and attention, mild to moderate impairments in phonological processing, and combined learning disorders. There was a relative similarity of cognitive profile though different ability levels. There was a pattern of higher functioning and average ability in Tina, who was born with lower PKU levels, and had a lower PKU level at the time of the evaluation, than her brother. During the past 3 years, Tim has become much more compliant with the PKU diet and evidences improved verbal ability on IQ testing as compared to testing done 3 years ago.

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S. PEARLMAN-AVNION. Theory of Mind in Developmental Pathologies: Theoretic and Methodological Issues.

The present research explored a facet of theory of mind (TOM) that indexes knowledge of other people's knowledge. Eight stories were presented to each participant, 4 of which involved false belief attribution. A comparison of performance was made among 11 participants with Williams syndrome (WS), 11 verbal-IQ-matched high functioning autistic participants (HFA), and 2 control groups of typically developing children, 7 and 11 years old. The test phase included 2 questions: the first monitored the understanding of reality, and the second monitored TOM (what would another person think). Based upon a conservative measure of TOM, cases where participants answered both questions correctly, the results showed that both pathological groups (HFA and WS) scored significantly lower than both control groups. Similarly, based upon the cases where participants answered only the first question correctly (understanding), regardless of the correctness of the second answer, control groups scored significantly better than pathological groups. Yet, based upon a third and more sensitive index, which divides the first index by the second, thereby representing the ratio between succeeding with TOM among all the cases when reality was properly monitored, HFA participants scored as high as the control groups. However, WS participants scored significantly lower than HFA, and both control groups. These results negate the preservation of TOM with WS participants, and are discussed in terms of the differences between WS and HFA patients in TOM, thus raising theoretical and methodological considerations.

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J. HUBER-OKRAINEC & M. DENNIS. Idiomatic Language Development in 6–17-Year-Old Children.

Idioms, nonliteral expressions whose meanings are not readily predictable from their literal parts, are important for discourse comprehension and learning. Comprehension varies with: *literality* (whether the idiom can be interpreted literally), *compositionality* (whether individual words contribute to a nonliteral meaning), and *linguistic context* (whether context supports a figurative meaning). We studied how these features influence idiom comprehension in 104 participants in 4 age groups: 6–7 years ($N = 24$); 8–10 years ($N = 24$); 11–13 years ($N = 24$); and 14–17 years ($N = 32$). Participants heard 48 idioms, either in isolation or with a supportive context, then saw the pictured idiom, either figurative or literal. They accepted or rejected the picture as the correct idiomatic meaning. Participants also saw a 4-choice display for each idiom and chose the best meaning from figurative, literal, lexically-related, and unrelated pictures. Accuracy and speed of comprehension improved with age. Younger children were significantly slower and made significantly more literal and lexically-related errors than older children. Linguistic context facilitated accuracy and speed of comprehension in younger children (6–10 years), but was not important for comprehension in older children (11–17 years). Idioms rated as high literal and nondecomposable were difficult for young children to comprehend. Low literality, regardless of degree of compositionality, facilitated comprehension throughout development. The results provide evidence for the source of developmental differences in speed and accuracy of idiom comprehension and suggest that older children access idioms more directly than younger children.

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C. RONCADIN, J.B. RICH, & M. DENNIS. Developmental Trends in Working Memory and Inhibitory Control.

Working memory (WM) is the ability to temporarily hold a limited amount of information in mind to carry out a cognitive task. Inhibitory control (IC) is the ability to keep irrelevant information from interfering with task at hand. Both are core cognitive functions essential to higher order thinking and problem solving. The individual roles of WM and IC have been studied, although the nature of their relation is less well established. The present study explored capacity and processing components of WM and IC in 96 normally developing children (8 children each from ages 6–17) using 4 tests derived from the Directional Stroop Task (Diamond et al., 1998). Participants were categorized by median splits as fast/accurate, slow/accurate, fast/inaccurate, or slow/inaccurate in WM capacity, WM processing, IC capacity, and IC processing. MANOVA revealed that in all cognitive domains, 6- to 8-year-olds were slowest and least accurate, and 15- to 17-year-olds were fastest and most accurate. For both WM and IC, capacity developed before processing. Performance on the IC capacity task developed fully by age 10, whereas performance on the other 3 tasks fluctuated from ages 9 to 15. Multiple regression analyses showed that IC capacity and processing, but not WM capacity, predicted WM processing. The results support the view that (a) WM and IC interact during development, and (b) WM development is in part dependent upon increases in IC.

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M. PULSIFER, K. RADONOVICH, J. HOFFMAN, M. O'REILLY, H. BELCHER, & A. BUTZ. Effects of Prenatal Drug Exposure on Cognitive Functioning in Young Children.

Recent research has suggested no significant differences in cognitive functioning between drug-exposed and non-drug-exposed children. The purpose of this present longitudinal study was to investigate the effects of prenatal drug exposure (cocaine/heroin) on cognitive and academic development in young children. Drug-exposed ($N = 56$) and control subjects ($N = 14$) matched for gestational age, current age, and SES were compared on measures of intelligence (Stanford–Binet), language (Preschool Language Scale), school readiness (Bracken), and attention (Gordon Diagnostic System) at 5 years of age. One-way ANOVAs showed that drug-exposed subjects scored significantly worse than non-drug-exposed subjects on indices of disinhibition and impulsivity (Gordon Delay Task Efficiency Ratio, $p = .04$), but not for visual attention/vigilance (Gordon Vigilance, $p = .21$). No significant differences were found between the 2 groups on measures of intelligence, language, school readiness skills, or short-term memory. These preliminary findings suggest that young children with prenatal cocaine/heroin exposure scored similarly to their non-drug-exposed peers in many cognitive and academic areas assessed; however, they exhibit a fundamental deficit in their capacity for inhibition, which results in impulsive behavior and poor self-control. This deficit places children with prenatal cocaine/heroin exposure at risk for classroom behavioral problems and for future learning problems. Professionals should be aware of these potential difficulties and be prepared to intervene with effective educational programming. Possible explanations for the current

findings and their implications will be discussed. This cohort will be followed to examine the progression of neuropsychological functioning in these children.
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B.C. LeJEUNE, P.S. FASTENAU, J.K. AUSTIN, & D.W. DUNN. Language and Behavior in Children with Recent-Onset Epilepsy.
Objective: Within a year of diagnosis, children with epilepsy already exhibit language delays and behavior problems (Fastenau et al., 1999). Because language delays are associated with behavior problems in other child populations, we examined whether language delays might be associated with behavior problems in a population with epilepsy. *Method:* Participants were 19 girls and 20 boys between the ages of 6 and 15 years ($M = 10.0$, $SD = 2.7$) who had recently been diagnosed with epilepsy (duration ranging 1–35 months, $M = 19.4$, $SD = 9.3$); children with mental retardation were excluded (K-BIT IQ $M = 103.0$, $SD = 11.9$). Tests included Clinical Evaluation of Language Fundamentals–3rd edition (CELF–3), Kaufman Brief Intelligence Test (K–BIT), and Child Behavior Checklist (CBCL). A negative correlation was hypothesized between language and behavior scores. *Results:* Pearson correlation between CELF–3 Total and CBCL Total was $r = -0.33$ ($p = .02$). On *post-hoc* analysis, Receptive and Expressive indices correlated equally with CBCL Total ($r = -.28$ to $-.34$). CBCL Internalizing Scale ($r = -.36$, $p = .01$) more strongly correlated with language than did the Externalizing Scale ($r = -.17$, $p > .10$). *Conclusion:* In children with epilepsy, language delays are more likely to result in internalizing behavior problems (e.g., depression, anxiety) than externalizing problems (e.g., hyperactivity, conduct disorder). Thus, language delays may place children with epilepsy at higher risk for emotional maladjustment, especially internalizing behaviors. However, children with internalizing symptoms may be less likely to be identified for treatment than those with externalizing symptoms.
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V. FRISK, M. BARNES, & H. WHYTE. Predicting Complex Language Impairments in Children Born Extremely Prematurely.
Weaknesses in the basic language skills of extremely-low-birthweight (ELBW; < 1000 gram birthweight) children following periventricular brain injury (PVBI) are apparent at least until school entry (Frisk & Whyte, 1994). This study examined whether weaknesses in the complex language skills of 8-year-old ELBW children were associated with PVBI sustained during the neonatal period, and whether weaknesses in basic language skills at school entry predicted weaknesses in complex language skills by Grade 3. Fifty ELBW children (No PVBI = 17; Mild PVBI = 22, Severe PVBI = 11) and 23 full-term controls, matched to the ELBW children for age and mother's education, completed the WISC–III and subtests from the Test of Language Competence (TLC) at 8 years. The ELBW children had completed the Peabody Picture Vocabulary Test–Revised, Expressive One Word Picture Vocabulary Test, and Test for Reception of Grammar at 6 years. Presence and severity of PVBI were significantly associated with impaired performance on the Ambiguous Sentences (AS) and Figurative Language (FL) TLC subtests, but not on the Making Inferences subtest. Performance on the vocabulary and grammar tests at 6 years accounted for significant amounts of the variance on the AS and FL subtests, after the effects of mother's education and intelligence were removed. Language weaknesses associated with PVBI clearly persist into the middle elementary grades. Weaknesses in basic language skills play a pivotal role in the later emergence of some complex language deficits, and have implications for oral language competence as well as academic functions such as reading comprehension.
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S.E. WOODROME, P.S. FASTENAU, D.D. DUNN, & J.K. AUSTIN. Auditory-Verbal Working Memory and Reading in Children with Chronic Epilepsy.
Objective: This study examined effects of age at onset and brain hemisphere localization of epileptiform activity on auditory-verbal working memory (AVWM) abilities and reading achievement in children with chronic epilepsy. *Method:* Participants were 25 children with ages at onset of 4 years or younger (early onset; age $M = 1.98$, $SD = 1.48$) and 27 children with ages at onset of 7 to 14 years (late onset; age $M = 8.78$, $SD = 1.48$). Twenty-one had right hemisphere seizure foci (8 early onset, 13 late onset) and 31 had left foci (17 early, 14 late). AVWM measures were Attentional Capacity Test (ACT) and Token Test for Children Part V (TTC). Reading achievement was assessed by Woodcock-Johnson-Revised (WJR) Letter-Word Identification (LW) and Passage Comprehension (PC). *Results:* There were no main effects or interactions for ACT or TTC ($p > .10$). There was a main effect for age at onset for LW, $F = 3.93$, and PC, $F = 4.51$, $p < .05$; scores were lower with earlier onsets. After covarying on working memory, there was a trend ($p < .10$) on both WJR subtests wherein children with earlier onsets of seizure activity performed worse than those with later onsets. In addition, there was a trend for lateralization on PC ($p = .10$) suggesting that children with right hemisphere foci performed worse than those with left foci. *Discussion:* Early onset of seizure activity in the right hemisphere appears to be more detrimental to AVWM and the learning-to-read process than are early left foci or later onsets.
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K. ESPY & P. KAUFMANN. The Internal Consistency of Delayed Response Type Tasks in Preschoolers.
Espy et al. (1999, 2001) have presented findings from several measures adapted from animal neuroscience and developmental paradigms to assess early executive functions in young children. Part of the task in test development is establishing reliability and validity. There are 2 aspects of reliability that are important—internal consistency, how items are related to each other and the total score, and test-retest reliability, how stable or consistent is performance at a given age. Data were aggregated from 2 studies of executive functioning in preschool children, aged 23 to 72 months ($N = 150$), although not all tasks were administered in both studies. The Kuder-Richardson formula for internal consistency was used because of the dichotomous response format on the delayed response type tasks. Results indicated that internal consistency ranged from .45 to .68. Tasks that were more difficult in the younger preschool children (Color Reversal, Spatial Reversal, Delayed Alternation) had somewhat lower reliabilities. On Delayed Response, where performance for some of the older children appeared to be at ceiling, internal consistency was higher. These results reflect the natural developmental skill variability of normal children whose executive functions are in a rapid phase of acquisition. Furthermore, these findings illustrate the challenges in developing suitable tasks for this age range. Further test-retest reliability studies are planned.
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Poster Session 7/8:00 a.m.–12:00 p.m.

LD/ADHD

D. MARKS, S. CYRULNIK, O. BERWID, A. SANTRA, E. CURKO, & J. HALPERIN. Relationship Between AD/HD Ratings and Working Memory in Preschool Children.
Recent models posit that school-aged children with AD/HD may possess deficits in one or more aspects of executive functioning (EF). In contrast, little is known regarding the extent to which such deficits exist in preschool children. This study examined the relationship between perfor-

mance on 2 computerized EF measures, Delayed Non-Matching to Sample Test (DNMST) and Recency Memory Test (RMT), and DSM–IV parent and teacher ratings of AD/HD symptoms in a nonreferred sample (N = 28) of 3–5-year-old preschool children. The DNMST requires participants to hold nonverbalizable geometric stimuli "on-line" in order to correctly discriminate between new and previously viewed figures. The RMT is a verbally mediated task that assesses memory for relative time in which children must indicate which of 2 previously viewed pictures was seen last or most recently. Pearson product-moment correlations revealed significant inverse relationships between parent *and* teacher ratings of hyperactivity-impulsivity (HYP-IMP) and performance on the DNMST (both $p < .05$), with higher behavioral ratings associated with poorer test performance. No significant relationships were found between performance on the RMT and any behavioral ratings. These data suggest a link between behavioral dysregulation (e.g., HYP-IMP), but not inattention, and nonverbal working memory in preschoolers. Furthermore, these findings are partially consistent with Barkley's Theory of AD/HD which emphasizes the importance of response inhibition for effective working memory.

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C.A. CHASE-CARMICHAEL, W.F. McKEEVER, & R. THOMAS. Inhibition, Executive Dysfunction, and Apathy as They Relate to Symptoms of ADHD.

Barkley (1997) has proposed that impairment of behavioral inhibition ("disinhibition") leads to executive dysfunction. This secondary impairment is, then, the cause of poor motor control and inability to adequately maintain attention, i.e., symptoms of ADHD. Both disinhibition and executive dysfunction are generally recognized to be common sequelae of frontal brain dysfunction. In the present study we assessed the performances of 145 female and 82 male undergraduates on the Conner's Adult ADHD Rating Scale (CAARS) and on the Frontal Lobe Personality Scale (FLOPS) of Paulsen et al. (1995). The FLOPS is intended by its developers to assess apathy, disinhibition, and executive dysfunction. Partial correlations of scores on the 3 subscales of the FLOPS with the 8 scales of the Conner's Adult ADHD Rating Scale were calculated. Results showed that, for females, the disinhibition subscale of the FLOPS was the best predictor of most CAARS subscale scores, a finding that lends support to Barkley's theory. Findings for males were less supportive of the theory, but this may be due, at least in part, to the smaller sample size of males.

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J. PRICE, K. KERNS, & R. McINERNEY. Executive Function in Action: An Analysis of the Children's Multiple Activity Test.

Measures of executive function can be classified into 2 groups based on the theoretical perspective they adopt. The reductionist "bottom-up" perspective views the meta-constructs of executive function (planning, organization, problem solving, etc.) as being composed of a number of fundamental, dissociable skills (e.g., working memory, inhibition). The "top-down" perspective views executive function *in vivo*: as the integrated sum of integrated processes. The advantage of top-down measures is that they allow for the examination of a behavior that requires the executive system without missing the complexity and interplay between the various executive components that is lost when they are examined in isolation (i.e., bottom-up). The top-down perspective has received more attention lately as the limitations of reductionistic bottom-up measures have become apparent. The current study proposed a potential top-down executive function measure for use with children, the CMAT. The CMAT was a computer-based, multiple task work environment that gave children the opportunity to earn points while performing four tasks that were simultaneously available on screen. Two groups of children (ADHD and control) were administered the CMAT, along with a selection of traditional neuropsychological measures of executive function (PASAT, Go/No-Go, CPT, etc.). Results showed that the CMAT proved to be an effective tool at differentiating those with suspected executive dysfunction (ADHD sample) from those without (control). In addition, regression analysis revealed that the CMAT total score could be predicted by using scores from a selection of traditional measures of executive function. Thus, the CMAT appeared to be an effective measure of the executive system in action.

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M.E. MAHONE, J.R. HIEMENZ, & J. PILLION. Attention and Motor Skills in Preschoolers with ADHD.

The core symptoms of attention deficit hyperactivity disorder (ADHD)—namely, distractibility, impulsivity and hyperactivity—are commonly seen in preschool children referred for developmental evaluation (Shelton & Barkley, 1993). Given that symptoms identified in preschool frequently continue throughout the school years (McGee et al., 1991), it is crucial to carefully assess these symptom patterns as early as possible. Unfortunately, development of diagnostic instruments to aid in differential diagnosis for preschoolers lags significantly behind those available for school-aged children (DeWolfe et al., 2000). We examined attention and motor skills in 12 unmedicated preschoolers (age 36–78 months) who had been diagnosed with ADHD, and 12 age- and sex-matched controls. Attention was assessed using the Auditory Continuous Performance Test for Preschoolers (ACPT–P; Mahone et al., 2000), Visual Attention and Statue subtests from the NEPSY, and the KABC Number Recall. Motor skills were examined *via* the NEPSY Visuomotor Precision and Imitating Hand Positions subtests. Group comparisons revealed no differences in estimated IQ between preschoolers with ADHD and controls; however, there were significant group differences (ADHD group performing more poorly) on omissions ($p < .05$) and variability ($p < .05$) from the ACPT–P, as well as Number Recall ($p < .05$), and both motor tests ($p < .05$). Among all measures, the NEPSY Visuomotor Precision subtest yielded the largest effect size in this sample. These findings highlight the salience of direct assessment of attention and motor skills in preschoolers suspected to have ADHD, and the utility of the ACPT–P and measures of graphomotor control in diagnostic evaluations of these children.

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P. ISQUITH, G. GIOIA, & K. ESPY. Development of the Behavior Rating Inventory of Executive Function–Preschool Version.

Assessing preschool-aged children's regulatory functions is important to facilitate treatment, yet remains complicated by a dearth of measures, by constraints of testing settings, and by the dynamic essence of the component processes. The structured nature of the assessment situation, combined with the lack of reliable and valid executive function measures for this age group, makes evaluation challenging. At the same time, parents and teachers possess a wealth of information about the child's behavior that is relevant to an understanding of their executive capabilities. We report on the development of a behavior rating inventory of executive function in preschool children aged 2 through 5 years that is designed as a tool for external validation of clinical assessment and as an easily administered, psychometrically sound means of evaluating executive difficulties. The measure is based on its predecessor, the BRIEF (Gioia et al., 2000), and includes 5 domains of executive function (Inhibit, Shift, Emotional Control, Working Memory, and Organization), each with 10 to 17 behaviorally anchored items. In initial parent (N = 372) and teacher (N = 201) samples, item-total correlations were in the appropriate range with good internal consistency for each scale ≥ .80 to .94). Scale-scale correlations were moderate (r = .3 to .6) and suggest unitary *versus* 2 factor solutions. Inter-rater agreement between parent and teacher reporters was moderate. There were significant, but small, age and gender differences in scale means. Continued study and development of the BRIEF–Preschool is ongoing to explore reliability and validity and to establish normative values.

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J. SHERMAN, M. McCLOSKEY, & C. SAVAGE. A 15-Year-Old Girl With a Selective Deficit in Perceiving Visual Orientation.
We report a case study of T.M., a 15-year-old girl with a selective deficit in perceiving and constructing the correct orientation of figures. T.M. was initially evaluated for difficulties with reading and her perceptual deficit was observed in her copy of the Rey Complex figure, which she produced in left-right and top-down reversed orientation. Her copy was otherwise well organized and was drawn quickly and efficiently. Orientation errors were also observed in her copies of simpler geometric figures (e.g., Benton VR figures) and appear to affect her reading and especially her spelling, where letter sequence is frequently reversed. Following her clinical evaluation, we administered experimental and standardized neuropsychological measures. Results indicate that T.M.'s visual orientation deficit does not vary with stimulus duration, motion, or contrast, as previously described in a case of a college student (McCloskey et al., 1995). Although T.M. occasionally provides the correct orientation, she is often unable to distinguish correct from reversed orientations, even when specifically directed to monitor and judge her accuracy. T.M. otherwise performed in the average to high average ranges on other neuropsychological measures and was neurologically normal upon evaluation with no history of neurological insult or disease. While perceptual orientation deficits have been described in patients with documented discrete lesions (e.g., Davidoff and Warrington, 2001), T.M.'s impairment appears to represent a developmental deficit in the perception of orientation. The implications of these findings for developmental disorders, such as dyslexia, will be discussed.
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J. JANUSZ, T. AHLUVALIA, & G. GIOIA. The Relationship Between Executive Function and Adaptive Behavior.
Adaptive behavior has a longstanding role in the clinical assessment of developmental disorders. Its relevance has expanded beyond mental retardation to a variety of other neurological disorders. The focus of adaptive behavior assessment on everyday functional independence suggests a relationship with executive function, which is equally concerned with independent social and cognitive problem-solving. This study examined the relationship between executive function and adaptive behavior in children *via* parent report. Parents of 41 children completed the Behavior Rating Inventory of Executive Functions (BRIEF) and the Adaptive Behavior Assessment System (ABAS) as part of a clinical evaluation. Participants were a mixed clinical sample of children (age range 5–17 years) diagnosed with attention deficit hyperactivity disorder, learning disabilities, autism spectrum disorders, and neurological disorders. Differential relationships between subdomains of executive function and adaptive behavior emerged. Significant correlations were found between the Social, Leisure, Self-Care, and Self-Direction scales of the ABAS and scales from both the Behavioral Regulation and Metacognition domains of the BRIEF ($r = -.35$ to $-.63$). The remaining scales of the ABAS (Communication, Community Use, Functional Academics, Home Living, and Health and Safety) were not significantly related to BRIEF scales. Inclusion or removal of specific diagnostic groups (e.g., autism spectrum disorders) did not significantly modify these significant correlations. Results support the discriminant validity of the BRIEF, while highlighting the contribution of executive functions to adaptive skills that are highly dependent on planning, organization, and modulation of one's behavior.
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S. SIKLOS & K. KERNS. Assessing Multitasking in Children With ADHD Using a Modified Six Elements Test.
The study was designed to investigate whether children with attention deficit hyperactivity disorder (ADHD) demonstrate a deficit in multitasking, measured by their performance on a modified Six Elements Test designed for use with children (C-SET). The C-SET was administered to 40 children, aged 7–13. The subjects comprised 2 groups: an ADHD sample ($n = 20$), and a community control sample ($n = 20$). The results show that the ADHD group performed significantly worse on the C-SET: the children with ADHD attempted fewer tasks than the control group, but did not commit more rule breaks. These findings suggest that children with ADHD did not have problems with prospective memory as the ADHD group was as able to keep the rule "on-line" as the control group. However, the ADHD children demonstrated a specific deficit in monitoring their ongoing behaviors and generating useful strategies for task completion, as indicated by the decreased number of tasks attempted compared to the control group. Our findings support the hypothesis that impairments in strategy generation, strategy application, planning, and self-monitoring may be primary deficits in children with ADHD.
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B. GJAERUM, H.G. TAYLOR, & E.B. FENNELL. Change and Prediction of IQ in Young Children With Neuropsychiatric Disorders.
Sample: 95 children from a sample of 219 preschool children with multiaxial neuropsychiatric comorbidity were assessed after 5 years. Mean CA was 5.1 years, with 85% below 7 years at first assessment (63% were boys, 42% were mentally retarded). Seventy-six children were reassessed with the same IQ test (Leiter IPS). Based on previous research, predictors of IQ would include Time-1 IQ, gender, and CNS-disorder. We further anticipated that poor psychosocial function would reduce IQ over time. *Research questions:* (1) Is the numerical change in IQ significantly different from zero and what is the direction of possible changes in IQ? (2) Which factors other than IQ at first assessment predict IQ 5 years later, and what are the positive and negative predictive values of the initial IQ? (3) Does correlation between IQ at 2 times reflect individual differences in stability in IQ across time? *Methods:* Groups were defined based on psychiatric disorder and initial IQ. Analytic procedures included GLM repeated measure analysis, linear regression analysis, bivariate correlation, and computation of negative and positive predictive power. *Results:* Overall, IQ scores declined over time, with no evidence for moderating effects of psychiatric group or initial IQ. Psychosocial impairment, CNS-disturbance, and gender added to Time-1 IQ in prediction of Time-2 IQ. High correlation between IQs at 2 occasions concealed large individual differences (>15 IQ points in 32%). *Discussion:* Psychosocial impairment is related to change in IQ. Males with CNS dysfunction are at particular risk for declining scores. Findings underscore the need for a third assessment.
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T. PETROS, F.R. FERRARO, L. JOHNSON, & S. JANTUNEN. Circadian Changes in Prose Recall in Children.
Previous work has demonstrated a circadian related change in passage memory in both children and adults. Folkard et al. (1977) found that children's immediate memory for passages declined from 9 AM to 3 PM. Petros et al. (1990) found that in younger adults, circadian changes in memory for passages depended upon whether the participant was a morning person or evening person. May et al. (1993) and Intons-Peterson et al. (1998) suggested that the size of adult age differences in memory may depend upon the time of day when participants were tested. The present study examined whether time of day of testing influenced children's memory for short passages used on a clinical test of memory in children and on longer passages used in laboratory experiments. Thirty-two children between the ages of 8 and 12 were tested either in the morning (9–10 AM) or the afternoon (3–4 PM). Participants were asked to listen to 3 short passages from the Wide Range Assessment of Learning and Memory (WRAML) and 4 longer passages (200–220 words) and immediately recall each passage. The results indicated that recall was higher for the

WRAML passages when participants were tested in the morning than the afternoon. In addition, recall was significantly worse in the afternoon than in the morning for the longer passages, especially for the most important idea units. The results of the present study suggest that assessments of children's cognitive and attentional performance may need to consider circadian variations in performance when arriving at diagnostic conclusions.
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P. CORMIER & C. POULIOT. Rey-Osterrieth Complex Figure in Children: Role of the Frontal and Parietal Lobes.
The present study provided a discriminative line of evidence for the claim that frontal mechanisms are implicated in the copy of Rey-Osterrieth complex figure (ROCF) in children. This claim does not rely on a comparison of the functioning of different lobes. Forty-four grade 1 children and 44 grade 5 children had to copy the ROCF. Then half of the children were randomly assigned to either a program approach or to a series of cues to draw again the ROCF. Each of these approaches had selectively helped patients with focal lesions to the frontal or parietal lobes (Pillon, 1981). Measures of parietal (Finger Localization Test and Tactile Form Perception Test) and of frontal lobe functioning (Verbal Fluency and Trail Making Test) were administered. The ROCF was drawn from memory after a 30 minute delay and a 1 week delay. Mixed design ANOVAS showed that training conditions enhanced reproduction of the ROCF overall, $F(1,80) = 65.68$, $p < .001$, except for grade 1 children in the cues condition, $F(1,80) = 10.67$, $p < .01$. This training effect was unaffected by the inclusion of measures of parietal or frontal lobe functioning as covariates and it did not affect recall. In short, programming helped young and older children in their copy of the ROCF and cues helped only older children. However, the effects of these training conditions were unrelated to markers of lobe functioning, suggesting caution in interpretation of these effects as well as the effects observed in the literature.
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P.M. PELLETIER, S.A. AHMAD, & B.P. ROURKE. Development and External Validation of Classification Rules for NLD and BPPD.
Two studies are reported. The goal of the first was to revise and improve rules for classification of 2 subtypes of learning disability, namely, basic phonological processing disabilities (BPPD) and nonverbal learning disabilities (NLD). Using a sample of 207 clinic-referred children with a learning disability (LD), the rules for classification of BPPD and NLD were refined and changes were made to improve their utility and render them easier to use. The goal of the second study was to validate these revised rules by comparing children classified as BPPD and NLD in terms of their patterns of psychosocial functioning. The revised rules for classification were applied to a new sample of 617 clinic-referred children with LD, 2 groups were formed, and the patterns of psychosocial functioning within the 2 groups were identified. For BPPD, the vast majority of group members exhibited a pattern suggestive of normal psychosocial adjustment and demonstrated no appreciable increase in incidence of significant psychosocial disturbance with advancing years. For NLD, the most characteristic pattern was internalized psychosocial dysfunction of a severe degree with increasing incidence with advancing years. These findings suggest that the rules of classification are valid. It is also clear that children classified as having BPPD or NLD using these rules exhibit very different, and predictable, relative patterns of psychosocial functioning. Consequently, these findings are consistent with the notion that the specific and distinct patterns of neuropsychological assets and deficits exhibited by these 2 subtypes of LD are predictive of important dimensions of psychosocial functioning.
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J. BYRNE, H. BAWDEN, J. DOOLEY, & H.L. LOUGHLIN. Neuropsychological and Psychosocial Profile of Preschoolers Diagnosed with ADHD.
Twenty preschoolers matched for sex and age, 10 with attention deficit hyperactivity disorder (ADHD) and 10 controls (CTRL) participated. Diagnosis was made by an experienced clinical psychologist, using DSM–IV criteria, with reference to standardized questionnaire profiles, child and family health histories, structured parental interview, and observation of the preschooler. Diagnosis was made independent of the neuropsychological and psychosocial measures. Five domains were assessed: (1) *Attention* [Picture Deletion Task–Preschool (PDTP): Omission Errors, Commission Errors]; (2) *Language* (WPPSI–R: Information, Comprehension); (3) *Visuospatial* (WPPSI–R: Object Assembly, Block Design); (4) *Memory* (NEPSY: Narration Memory); as well as (5) *Psychosocial* (FAM–III: GS, PSI: TS). There was a statistically significant relationship between the *Attention* and *Visuospatial* domains. No statistically significant relationship existed between *Attention* and *Language* domains, or between *Attention* and *Memory* domains. Even when statistically controlling for influence of *Attention* domain, preschoolers with ADHD had significantly lower scores in the *Visuospatial* domain. There was no group difference with regard to the *Language* or *Memory* domains. In the *Psychosocial* domain, parents of preschoolers with ADHD rated level of family functioning (FAM–III:GS) as significantly lower, and level of parent–child stress (PSI: TS) as significantly higher, compared to parents of controls. Discussion is made with reference to the fact that: (a) early neuropsychological and psychosocial profiles may assist in distinguishing preschoolers with ADHD from their peers; and (b) preschool inattention cannot fully account for observed differences in early neuropsychological functioning.
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S. PEARLMAN-AVNION & Z. EVIATAR. Irony Understanding Preservation in Nonverbal Learning Disabilities.
We explored cognitive and social behavior as well as a facet of theory of mind (TOM) that indexes knowledge of other people's emotional state. In the first experiment we used the Matson Evaluation of Social Skills with Youngsters questionnaire to compare the social skills of 9 participants with nonverbal learning disabilities (NVLD) and 9 verbal IQ- and age-matched 11-year-old controls. In accordance with previous reports, NVLD participants scored lower on short-term, and even more so on long-term appropriate social skills. On the basis of a discriminative cognitive and social profile of these groups the next experiment was conducted. In this second experiment, we auditorily presented these participants with 16 irony and literal stories. After each story 2 questions were asked, the first monitored the understanding of reality, and the second monitored TOM (what another person feels). Based upon 3 different indexes, NVLD participants scored as high as the control group in attributing emotional states to others in the ironic as well as the literal stories. We used a conservative measure of TOM (cases where participants answered both questions correctly), an understanding index (cases where participants answered only the first question correctly), and a third and more sensitive index, representing the ratio between succeeding with TOM among all the cases when reality was properly monitored. These results are discussed in the context of 2 diverging frameworks: the suggested right hemisphere deficiencies of NVLD, and the recent findings regarding the involvement of both right and left hemispheres in irony comprehension.
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V. LOZANO & K. KRULL. A Structural Equation Model of Attention Tasks in Clinic-Referred Children.
A structural equation model was constructed from 4 measures that tap attention administered to 185 school-aged children with attention deficit

hyperactivity disorder (ADHD–I, $n = 43$; ADHD–C = 142) referred to a clinic for attention problems. All children completed the Gordon Diagnostic System (GDS), the Random A's Cancellation test (Random A's), the Beery Visual-Motor Integration Visual Perception (VMIP) subtest, and the Stroop Color-Word Reading Test (Stroop) as part of a larger clinic battery. Four of the 6 GDS commission error subtypes loaded on 1 factor felt to tap inattention. The other 2 commission error types did not load on any factor. GDS reaction times (RT) for blocks 1–3 loaded on a reaction time factor. Correct responses on the Random A's and VMIP tests loaded on a factor felt to tap focused attention. The Stroop did not load on any factor. The GDS inattention factor significantly predicted the focused attention factor and performance on the Stroop interference trial. Future analyses will focus on the utility of attention measures in predicting parent and teacher rating scales of attention and hyperactivity. In addition, differences in prediction between the ADHD–I and ADHD–C subtypes, boys and girls, younger and older children, and medicated and nonmedicated children will be considered.

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R. BURMEISTER, K. KRULL, L. BUONO, & J. FEIGIN. Analysis of the Performance of ADHD Subtypes on a Continuous Performance Task.

The DSM–IV designates 3 subtypes of attention deficit hyperactivity disorder (ADHD). The most prevalent subtypes are ADHD: Combined Type (ADHD–C) and ADHD: Predominantly Inattentive Type (ADHD–I). Although there are distinct behavioral criteria used to classify these 2 subtypes, there has not been much evaluation of distinct performance differences on attention and vigilance measures, such as the continuous performance task (CPT). Differences in performance on the CPT, specifically differences in commission error rate and type, have not been examined. Gordon Diagnostic System visual vigilance task data was collected for 60 children (ages 6–14) who were referred to an attention problems clinic. Participants were classified into ADHD–I and ADHD–C groups by their scores on parent and teacher behavioral rating scales. An analysis of variance was conducted examining the error performance of the 2 groups. Previous factor analysis of the commission error subtypes revealed that a majority of error types load on a quick response factor thought to reflect disinhibition. Therefore, it was hypothesized that the ADHD–C group would commit a greater number of commission errors than the ADHD–I group. It was also hypothesized that the ADHD–C group would commit a greater number of errors consistent with the "disinhibition" factor, and the ADHD–I group would commit a greater number of errors consistent with the "slow processing" factor. Analyses appear to support these hypotheses. This suggests that although both ADHD subtypes exhibit attention deficits, they can display differential performance on attentional measures, which might suggest different underlying psychological processes.

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E.R. WALTON, J.F. KULAS, & L.D. STANFORD. The Performance of Children with ADHD on Timed Measures of Academic Fluency.

Children with attention deficit hyperactivity disorder (ADHD) often perform less efficiently on tests that have a timed component. Neuropsychological tests can be used to make classroom-specific recommendations for children diagnosed with ADHD. From a diagnostic viewpoint, the ability of a test to distinguish ADHD from the normal population is valuable. This study compared performances of children with ADHD to patient controls on standardized measures of reading, writing, and math fluency (under time demand). An additional test of oral fluency was also used in an effort to determine its diagnostic efficacy with an ADHD population. The scores of 10 ADHD patients age 7–14 from an outpatient referred clinical sample were compared to eight non-ADHD patient controls age 7–16. The mean scores for the ADHD patients on the reading ($M_{\text{reading}} = 100.20$), writing ($M_{\text{writing}} = 105.90$), and mathematics ($M_{\text{mathematics}} = 103.4$) fluency tests were slightly higher than the means of the patient controls ($M_{\text{reading}} = 96.63$, $M_{\text{writing}} = 98.50$, $M_{\text{mathematics}} = 95.13$). In contrast, patient controls scored slightly higher on oral fluency ($M_{\text{oral fluency}} = 103.63$) than ADHD patients ($M_{\text{oral fluency}} = 98.00$). However, no statistically reliable difference between the 2 groups was found on any of the measures. Despite expectations that children with ADHD might be less efficient on timed measures of academic tasks, the children in this study performed at the average range. Implications from this study include the need to review the clinical practice of recommending ADHD students be allowed untimed testing in school.

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P. CIRINO, K. STEINBACH, M. De PALMA, J. FRIJTERS, A.F. SMITH, R. SEVCIK, M. LOVETT, M. WOLF, & R. MORRIS. Math Disorder Comorbidity and Intervention in Children with Reading Disorder.

We examined math disorder (MD) comorbidity and intervention in a cohort of children ($N = 114$) with reading disorder (RD) who received 70 sessions of either reading (direct instruction of phonology, $n = 54$) or math ($n = 60$) intervention over the course of an academic year. MD and RD were defined utilizing low achievement and discrepancy criteria. Outcome measures were subtests from the WRAT–3 and KeyMath. Sixty-two children (54%) were identified as having a MD; immediately after completion of the intervention, only 48 (42%) of the children met criteria for MD. Performance improved on 5 of 7 measures over time, and a trend ($p < .09$) was noted for a sixth (KeyMath Time and Money); improvement likely was not related to practice effects (Cirino et al., submitted). Time and Money (KeyMath) exhibited a significant time by treatment interaction ($p < .02$), and a similar trend ($p < .08$) was noted for Numeration (KeyMath); those who received math intervention improved more than those receiving reading intervention. For WRAT–3 Arithmetic scores, those with a MD improved ($p < .04$) more over time than those who did not. These results provide further evidence for the comorbidity of MD in RD, and treatment specific gains on selected measures; nonspecific improvement was noted on most other measures. Although math intervention can be effective, the type of intervention and the type of outcome measure are important factors to consider, and future work will aim to distinguish characteristics most predictive of change over time in children with MD and RD.

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C. MILLER, J. SANCHEZ, G. HYND, & S. MILLER. Behavioral Profiles of Children with Dyslexia and ADHD in a Clinical Sample.

The DSM–IV criteria (American Psychiatric Association, 1994) for attention deficit hyperactivity disorder (ADHD) require the presence of externalizing behaviors for diagnosis, but the presence of internalizing disorders is less clear. Studies of children with developmental dyslexia suggest a link between dyslexia and internalizing disorders, such as anxiety disorders and depression, but the role of externalizing behaviors in dyslexia is also unclear. From an existing clinic database, 71 subjects were selected that were diagnosed with ADHD, dyslexia, or comorbid dyslexia and ADHD. An additional 9 subjects were identified that did not meet the diagnostic criteria for a disorder, but had been referred to the clinic for learning and/or behavior problems. Preliminary analyses of the data yielded no statistically significant differences between groups on variables of age, gender, grade in school, VIQ, PIQ, or Full Scale IQ, as measured by the WISC–III. Analyses of variance were used to investigate differences between the groups on mother and teacher ratings of internalizing and externalizing behaviors using the BASC. Overall, mothers' ratings more closely matched diagnostic status than teacher ratings of behavior. According to their mothers, children with comorbid diagnoses of dyslexia and ADHD demonstrated more internalizing symptoms, especially depressive symptoms, than children diagnosed solely with ADHD or dyslexia. Additionally, mothers reported a general trend toward more anxiety-related behaviors

in children with dyslexia diagnoses than with ADHD diagnoses or no diagnosis. In general, mothers of children with comorbid diagnoses report more externalizing and internalizing behaviors than mothers of children with diagnoses of dyslexia or ADHD alone.

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C. KANG, L. HUMPHREY, & E. LOPEZ. Trials to First Category of WCST Discriminates Between ADHD and Clinical Controls.

Children with ADHD struggle with symptoms of inattention and poor executive functioning (EF). A specific complaint is difficulty initiating complex tasks. Children with varying degrees of brain dysfunction are often reported to struggle with issues of inattention and EF. The current study compares deficits in EF between these 2 groups. The Wisconsin Card Sorting Test (WCST) has been found to differentiate ADHD children from normal controls on a number of indices. A less-reported variable from the WCST (trials to first category) may reflect the difficulty with task initiation. Grodzinsky and Diamond (1992) reported that this variable was significant in discriminating normal male controls from boys diagnosed with ADHD. The current study compared ADHD children to those with other brain-based disorders. Thirty-five children were diagnosed with ADHD using parent interview and behavioral questionnaires completed by parents and teachers. The clinical control group of 20 were diagnosed with other medical conditions or developmental disorders. The groups did not differ on age, FSIQ, or sex. Children diagnosed with ADHD had significantly more difficulty completing the first category of the WCST ($p < .013$). Further analysis indicated that children with predominantly inattentive symptoms were the most discrepant from the clinical controls ($p < .007$), though an ANOVA did not discriminate between subtypes of ADHD on this variable. This variable offers a more detailed differentiation between characteristics of children with ADHD. This specificity is needed to assist in clarifying the heterogeneity apparent in the disorder.

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M.L. SMITH, E. KERR, H. CHEVALIER, J. SALTZMAN, & M. MACKAY. Nonverbal Learning Disability in Children with Left Hemisphere Lesions.

Nonverbal Learning Disability (NLD) is characterized by deficits in visual-spatial organization, motor skills, attention to visual and tactile input, math, reading comprehension, and social behaviors, in contrast to relatively well developed verbal skills, reading decoding, spelling, and rote auditory attention and memory. Although first described as a syndrome associated with right hemisphere abnormality, it has more recently been attributed to damage to white matter connections. Nonetheless, the association with the right hemisphere remains paramount in the beliefs of many psychologists and educators. Here we present 2 cases with NLD who have left hemisphere cortical dysplasia and underwent epilepsy surgery. Both were left-handed and had onset of seizures in infancy. Case 1 had a left occipital resection and multiple subpial transections (MST) in the parietal cortex at age 4 years and has remained seizure free for the 3.5 years after surgery. Case 2 had a left posterior quadrant cortisectomy with MST over the left frontocentral regions at age 12, but continues to have seizures arising from left fronto-centro-parietal regions. Both children had strengths in learning and retention of rote auditory information, simple language expression, spelling, and word decoding. Their deficits encompass fine motor skills, visual processing and reasoning, visual learning, concept formation, problem solving, reading comprehension and mathematics, processing novel and complex information, and social judgment. These cases illustrate that NLD should not be automatically equated with right hemisphere or white matter abnormality. Reorganization of function may have had a role in the genesis of the NLD profile in these children.

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T.D. DUCKWORTH, D.A. BECKER, & E.B. FENNELL. Does IQ Make a Difference in the Assessment of African American Boys with ADHD?

Behavior rating scales are commonly used in the assessment of attention deficit/hyperactivity disorder (ADHD). Research using the ADHD–IV behavior rating scale has shown significant differences in the scale's performance in European American and African American samples. However, these studies have failed to control for the well-documented one standard deviation difference in IQ scores between European Americans and African Americans. The current study examines the potential impact of IQ on scores on the Conners' Parent Rating Scale-Revised Long Version (CPRS–R:L) in a diverse sample of boys ($N = 88$) ages 6–16 referred to a large teaching hospital-based psychology clinic for attentional problems. Consistent with previous research, *t*-tests revealed significant differences between the 2 groups on the Wechsler Intelligence Scale for Children–3rd Edition (WISC–III) Full Scale IQ (FSIQ), Verbal Scale IQ (VSIQ), and Performance Scale IQ (PSIQ) (t's (90) = −4.75, −3.96, and −4.57, respectively). For the entire sample, significant correlations were found between FSIQ, VIQ, and PIQ and the CPRS–R:L Anxious/Shy, Perfectionism, and Social Problems scales. There was a trend toward significantly higher scores on the Perfectionism subscale for African American boys ($p > .026$, n.s.). Although these results suggest that there are no significant differences in the CPRS–R:L between clinic-referred African American and European American boys, further research with larger sample sizes is needed.

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K.J. RADONOVICH, J.T. CARR, M.B. DENCKLA, & S.H. MOSTOFSKY. Time Judgment and Production in Children with ADHD.

Individuals with ADHD often have difficulties with "time management." Impaired performance of children with ADHD on a time reproduction task has also been reported (Barkley et al., 1997). Underlying these observed deficits might be an inability to judge time intervals and/or a deficit in timed motor production. Another possibility is that timing itself is not deficient, but there is impaired utilization of temporal information by "executive systems," i.e., working memory, organization, or inhibition. In order to address this question, we used tasks designed by Ivry and his colleagues to specifically assess time judgment and timed motor production abilities, while minimizing demands placed on executive functioning. ADHD subjects ($N = 27$) and normal controls ($N = 27$) were compared on a judgment of time task and a timed motor production task. Subjects were matched on age, sex, and full-scale IQ variables. Primary analyses using standardized *t*-tests revealed no significant differences between the groups on judgment of time ($p = .36$) or timed motor production (measured as *SD* of inter-tap intervals, $p = .89$). Additional indices of explicit timing mechanisms were also not significant (Clock delay, $p = .40$; Motor delay, $p = .75$). Results do not appear to support previous findings of impaired judgment of explicit time intervals or time production in children with ADHD. It appears that clinically observed deficits in "time management" in ADHD may be secondary to deficits in executive functions, such as working memory, organization, or response inhibition.

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D. MARKS, S. CYRULNIK, O. BERWID, A. SANTRA, & J. HALPERIN. Parent-Teacher Concordance and Factor Structure of AD/HD Ratings in Preschoolers.

Numerous studies have investigated the factor structures of, and relationships between, parent and teacher ratings of AD/HD symptoms in school-aged children. However, similar studies have yet to be conducted in preschool children. Parent and teacher ratings of inattention (IN) and hyperactivity/impulsivity (HYP-IMP) were collected in a nonreferred sam-

ple of 113 preschool children (mean age = 4.48 years) using a checklist, which required the informants to rate the severity of the 9 IN and 9 HYP-IMP DSM–IV AD/HD items on a 4-point scale (0–3). Gender differences were observed for teacher, but not parent ratings of IN and HYP-IMP (both $p < .001$), with males receiving significantly higher scores on both behavioral dimensions. Cross-informant Pearson product-moment correlations revealed significant parent-teacher concordance for ratings of HYP-IMP ($r = .42$, $p < .001$), but not for ratings of IN ($r = .15$, $p > .10$). A principle components factor analysis with varimax rotation yielded a 2-factor solution for teacher ratings (69% of the variance explained) corresponding to that of the DSM–IV AD/HD factor structure (i.e., separate IN & HYP-IMP domains). However, the majority of the variance (58%) was accounted for by the HYP-IMP factor. Factor analysis of parent ratings, which accounted for 67% of the variance, again revealed a strong HYP-IMP factor (41% of the variance), but failed to isolate a unitary attention construct, with items splitting their variance across 3 additional factors. These data suggest that variations in HYP/IMP behaviors are evident across settings in preschool children, whereas IN behaviors may be less discernable in this age group.
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D. WABER, P. FORBES, & M. WEILER. Neurobehavioral Correlates of Referral for Learning Problems: An Adaptive Model.
Although formal definitional criteria for learning disability (LD) require a specified discrepancy between aptitude and achievement scores, in practice, school decisions often reflect clinical judgment. The neuropsychological research on LD, nevertheless, persists in focusing on the rigid definitions, limiting applicability to real-world settings. We prospectively evaluated 201 school children from a single community, ages 8 to 11, for cognitive ability, academic achievement, low-level information processing, and DSM–IV ADHD symptoms. Seventeen of these children were referred for evaluation of learning problems during the 2-year study. The community referred (CR) children had ability and achievement scores that were at comparable levels (Mean K-BIT Composite = 100.1; Mean WIAT Basic Reading = 102.9). None met criteria for ADHD Combined. Yet they performed more poorly than the community nonreferred children in all neurobehavioral domains ($p < .05$), corroborating the legitimacy of their referral. The CR group did not differ from a demographically comparable hospital referred (HR) group ($N = 203$) or from a group from their own community enrolled in special education (CSE, $N = 30$) in terms of cognitive ability, low-level information processing, or attention symptoms, but the HR group had poorer academic skills. Referral for evaluation of learning problems is more likely to reflect a child's neurodevelopmental risk relative to local community norms than a specific disability diagnosis that is comparable to the physical disabilities.
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S.E. CAUDLE, D.D. CAUDLE, K. MILLER, D. BLOOM, & K. KRULL. Differences in Processing Speed Between ADHD Subtypes.
The present investigation examined differential patterns of response speed and error rate among children with attention-deficit/hyperactivity disorder–combined type (ADHD–C) and predominantly inattentive type (ADHD–I). Data were obtained from 32 children referred to an attention disorders clinic and diagnosed with ADHD (ADHD–C, $n = 21$, ADHD–I, $n = 11$). Groups were found to be similar in terms of parental education, gender composition, and intellectual functioning (Differential Ability Scales). Differences were observed for age at assessment, with the ADHD–C children presenting at an earlier age, consistent with the current literature. In general, results supported the theory that children diagnosed with ADHD–I have a slowed processing speed in comparison to children diagnosed with ADHD–C. With age statistically controlled, the ADHD–I group demonstrated reduced psychomotor speed on the Purdue Pegboard Test and Woodcock-Johnson–Revised subtests (Cross Out and Visual Matching), reduced reaction time on the vigilance subtest of the Gordon Diagnostic Test, and slower color and word reading on the Stroop Color Word Test. In contrast, the ADHD–C group evidenced increased impulsivity and disinhibition by committing higher rates of errors on the Trail Making Test (Part B) and overall lower scores on the Stroop Color Word Test interference subtest. The present study supports the contention that sluggish cognitive tempo be revisited as an appropriate diagnostic criteria for ADHD–I.
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M. LARSEN, G. ALESSI, H. PRATT, & M. SLOANE. Conditional Probabilities: Comparison of ADDES and DSM–IV Criteria Ratings.
Attention deficit hyperactivity disorder (ADHD) seems to be growing in epidemic proportions, with point prevalence rates ranging from 1% to 20% (DuPaul, 1990a; Kohn, 1989; among others). Teachers and school counselors, pediatricians, and many parents are becoming more aware of the iatrogenic effects of ADHD. In addition, there is no pathognomic feature that serves to replace significant assessment and evaluation in the diagnosis of ADHD. The effectiveness of common screening and assessment tools was evaluated based on conditional probabilities modeling. These assessments were also compared to a measure developed using the exact wording of the DSM–IV (APA, 1994) comprehensive criteria. Parents of children with diagnoses of chronic medical (asthma), ADHD, and no medical/mental health condition participated in this study, conducted both in a teaching clinic and private pediatric practice. Parents completed the ADDES and Child Symptom Rating Scale (CSRS: developed for this study) among other common assessment measures. Comparative analyses indicate that there are considerable differences based on interpretive level (number of criteria used for diagnosis, percentage of time emitting symptoms) as well as prevalence level used to identify ADHD compared to the physician endorsed sample or DSM–IV classified sample. The ADDES showed generally accepted predictive values, however the CSRS demonstrated lower consistency. This finding is curious given the basic assumption that DSM/ICD disorder taxonomy are to define and identify disorders accurately and consistently. Discussion will address diagnostic and categorization issues. The utility of conditional probabilities in the development of measures and implications for assessment will be addressed.
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R. ROTH, J. MIELKE, H. WISHART, L. FLASHMAN, H. RIORDAN, L. HUEY & A. SAYKIN. Contribution of Executive Functions to Memory in Adult ADHD Before and After Methylphenidate.
We recently found that verbal learning and memory deficits in adults with attention-deficit hyperactivity disorder (ADHD) are mediated in part by impaired semantic organization during encoding. In the present study, we extended our prior work by (1) evaluating whether working memory and sustained attention also contribute to the memory deficits; and (2) determining whether changes in memory following methylphenidate are related to changes in executive functions and/or sustained attention. (1) *Pre-Treatment:* Participants: 28 unmedicated nondepressed adults with ADHD and 34 healthy controls. Participants completed the CVLT, Gordon CPT, and Digit Span Backward. Results: Working memory significantly mediated group differences in verbal learning, while semantic organization contributed to both learning and delayed recall. Working memory and semantic organization independently contributed to the prediction of pre-treatment group differences. (2) *Post-Treatment:* Participants: A subset of 22 ADHD patients were re-tested following treatment with methylphenidate for an average of 5 weeks. Results: Significant improvement following treatment was noted for short delayed recall, working memory, and sustained attention. However, these changes did not covary significantly. *Conclusions:* Findings suggest that working memory and semantic organization contribute independently to verbal learning and memory deficits in adults with ADHD prior to treatment, but improved verbal memory

following methylphenidate is unrelated to improvements in working memory or sustained attention. Replication in larger samples will be required to determine the reliability of these findings.
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M. ZUCKER, M.K. MORRIS, S. INGRAM, R.D. MORRIS, & R. BAKEMAN. Self-Informant Rating Concordance for Adults' Current and Childhood ADHD Symptoms.
Concordance of self and informant ratings of childhood and current ADHD symptoms was assessed in 281 college students evaluated for learning problems. Concordance on parallel forms of a behavior checklist of ADHD symptoms was assessed at the subscale (Inattention, Hyperactivity-Impulsivity) and individual symptom levels. Potential demographic (age, sex) and diagnostic (ADHD, learning disability) moderators of concordance were also investigated. Concordance levels were similar for current and childhood symptoms. Moderate but significant positive correlations were found between self and informant ratings on the Inattention and Hyperactive-Impulsive subscales. However, weighted kappa coefficients for agreement on individual symptoms ranged from fair to substantial. Despite positive correlations, the level of symptom severity on the Inattention subscale differed, with informants rating participants higher. Consequently, more adults met criteria for ADHD by informant-report than self-report. Both demographic and diagnostic moderators of concordance were identified. Concordance was lower in adults with ADHD for current and childhood inattention, but higher for childhood hyperactivity-impulsivity. Additionally, concordance for childhood symptoms was stronger for females than males. Differing levels of concordance for global subscale scores and for endorsement of specific symptoms have implications for the use of behavior rating scales in the diagnosis of ADHD. Evidence for systematic interobserver differences in ratings of symptom severity raises questions about the validity of both self and informant ratings, as both types of ratings are susceptible to bias. These results also support the need to investigate individual difference variables that may impact the concordance of self and informant reports of ADHD symptoms in adults.
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J. WASSERSTEIN, G.A. STEFANATOS, & M. FINDLER. ADHD Adults and the Right Executive: Implications of Differential Performance on Verbal and Design Fluency.
Converging data has argued that core ADHD symptoms predominantly reflect dysfunction in prefrontal brain regions and related striatal circuitry. A subset of these studies describe lateral asymmetries that particularly implicate *right*-sided corticostriatal pathophysiology, although supporting neuropsychological test data is limited. This study examines the right hemisphere hypothesis of ADHD in 10 young adults (6 males) meeting DSM–IV criteria (5 predominantly Inattentive Type, 5 Combined Type). All were unmedicated and without significant comorbid psychopathology. Each was given an extensive ADHD battery which included Conner's CPT, SCL-90, several ADHD rating scales (Brown and Wender), and 2 complementary lateralized frontal measures: FAS and RUFF Figural Fluency test (i.e., for left and right sides, respectively). Results were consistent with greater right than left-sided impact in a high functioning ADHD sample. Ninety percent showed weaker performance on the RUFF which was significant by Sign Test. All were average or better on the FAS (mean = 54th percentile). By contrast, 50% were Low Average or less on the RUFF (mean = 27th percentile), with 30% earning frankly borderline or defective scores. Differences were statistically significant and findings appear unrelated to type of ADHD. We also describe concurrent results and changes on psychostimulant medication.
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R. DRECHSLER, D. BRANDELS, M. FÖLDENYI, & H.-C. STEINHAUSEN. Course of Neuropsychological Symptoms in ADHD Over Two Years.
Objective: Children with ADHD frequently show a remission of symptoms into adolescence, as indicated by longitudinal studies typically covering more than 3 years. The purpose of this study was to investigate neuropsychological changes over a shorter period of time with a standardized computer battery for attentional and executive functions. *Method:* Children with ADHD (off medication for 48 hr) and normal controls (N = 30 each) were examined at baseline and after 2.4 years. They performed 2 tasks of the Test for Attentional Performance (TAP): A test of simple reaction time to visual stimuli, contrasting a condition with and without auditory warning signal (alertness), and a task of spatial interference/inhibition of a dominant response (incompatibility). Age and IQ were entered as covariates. *Results:* In the alertness task, groups did not differ in mean reaction time, but children with ADHD showed significantly more response time variability at the first examination, especially in the condition without warning signal. Differences in variability disappeared after 2 years. In the incompatibility task, the number of errors distinguished the groups only at the second examination, whereas differences in response time and its variability were not significant at any time of testing. Both groups showed effects of maturation and reduced distractibility over time. Changes in diagnosis (DSM–III–R) after 2 years could be predicted best by the initial measures from the alertness task.
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A. VÉLEZ, E. GÓMEZ, & F. OSTROSKY-SOLIS. Neuropsychological Assessment of Attention: Effect of Age and Sex.
Attention can be defined as the selection process that occurs in response to the limited capacity of information processing. Controversy exists about how many kinds and subprocesses of attention can be distinguished, however some authors have included: selective attention, sustained attention, and attentional control. Attention is a prerequisite for the appropriate operation of other abilities and, in turn, can be affected as a consequence of several pathologies. The objective of this study was to describe the effects of age and sex in several types of attentional processes. A sample of 471 subjects from 6 to 20 years old was assessed with the Neuropsi Attention and Memory (Ostrosky-Solis et al.). This battery evaluates orientation, attention, memory, and executive functions. The age factor had a significant effect in most of the tasks. However the sex factor didn't show any differences. These data suggest a differential maturity of the cortico-subcortical structures that underlie this process, and they point out the importance of having developmental norms for accurate diagnosis between normal and pathological processes.
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A. KUNIN-BATSON, M. PRIMEAU, F. ZELKO, M. GLANZMAN, D.R. MARTINI, & R. ERWIN. Effects of Methylphenidate on Neuropsychological Functioning in Children with ADHD.
Stimulant medications have become the most widely used treatment for attention deficit hyperactivity disorder (ADHD), and have proven helpful for the core symptoms of overactivity and impulsivity. However, the effects of stimulants on neuropsychological functioning are complex and only partially understood. Research informed by theoretical models that demonstrate the multidimensional nature of attention should help specify the effects of pharmacotherapy. A double-blind, placebo-controlled design and a multifactorial model of attention (Mirsky et al., 1991) were used to examine the effects of a moderate dose of methylphenidate (MPH) on components of attention and behavior in 17 boys (ages 7–13) with ADHD-Combined Type. It was hypothesized that MPH would have nonspecific

effects upon components of attention and behavior. It was further hypothesized that changes in neuropsychological measures would predict changes in parent report of executive behaviors (Behavior Ratings Inventory of Executive Function) and ADHD symptomatology (Child Attention Profile). MPH improved only the Sustain ($p = .002$) and Stability ($p = .000$) components of Mirsky's model (vigilance and consistency of attentional effort), as well as auditory ($p = .01$) and visual-spatial ($p = .005$) working memory. MPH was associated with global improvements on the parent-reported BRIEF ($p = .005$) and CAP ($p = .04$). Changes in neuropsychological measures did not significantly predict changes in parent-reported behavior. Results are discussed in terms of the mechanism of stimulant response, components of attention, and measurement issues.
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A. CAVANAUGH-SAWAN & C. ARMENGOL. Differential Performance of PTSD, ADHD, and a Nonclinical Control Group of Children on Tests of Attention and Inhibition.
This study presents the results of a comparison between children with ADHD, PTSD, and a nonclinical control group on 2 tests measuring activation, attention, and inhibition (Vigil CPT and Stroop). There were 15 males ages 9–12 in each group. Subjects in the ADHD and PTSD groups met DSM–IV criteria, and a test of general intelligence (K–BIT) was administered to exclude individuals who were not in the average range. Results indicated no differences in RT on the vigilance or on the Stroop test between the 3 groups. The PTSD group did as well as controls on errors of omission, but made significantly more errors of commission. The ADHD children performed the worst, making significantly more errors of omission than either the controls or PTSD groups, and as many errors of commission as the PTSD group. Implications for theoretical models involving neurotransmitters are discussed.
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A. MAERLENDER, P. ISQUITH, G. GIOIA, & K. ESPY. Assessment of Executive Function in Preschool Children *via* Everyday Behaviors.
The relationship between executive dysfunction and attentional disorders (ADHD) has been described for school-aged children (e.g., Pennington & Ozonoff, 1996; Barkley, 1997, 2000). Few studies have explored this relationship in preschool-aged children, given the challenge of clinical measurement of executive function in this younger population (Espy et al., 2001). Further, the developmental trajectory of executive function, presumably reflecting neural maturation, remains less defined in younger children. Tentative models of executive function underlying ADHD have been posited for school aged children (Gioia et al., 2001; Kelly 2000) but may differ substantially for preschoolers. The current study explored the relationship between executive function, as expressed in everyday behaviors, and diagnostic characteristics of ADHD. Parents of 49 boys and 32 girls ages 2 through 5 years, with no identified neurological or psychiatric diagnoses, completed preschool versions of the Behavior Rating Inventory of Executive Function (Gioia et al., 2000) and the ADHD Rating Scale–IV (DuPaul et al., 1998). Results of a 2 factor solution *via* exploratory PFA yielded strongly correlated factors ($r = .67$): One factor was defined by the BRIEF Working Memory and Organization scales and the ADHD–IV Inattention scale, accounting for 61% of variance. The second factor reflected behavioral inhibition, defined by the BRIEF Inhibit and Emotional Control scales and the ADHD–IV Hyperactive/Impulsive scale, accounting for 7% of variance. The BRIEF Shift scale had shared loadings on both factors. These findings highlight the presence of emerging executive function, and the potential for behavioral assessment of executive function, in preschool-aged children.
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Paper Session 18/9:00–10:45 a.m.

ATTENTION

B. GEYER, C. FRIEDMAN, D. POGGE, & R. HURON. The Convergent Validity of Measures of Attention.
The convergent validity of neuropsychological measures of attention and rating scale measures of attention, hyperactivity, and impulsivity was investigated. Attention is an important factor in a child's achievement, but there is no consensus on how to best measure this unobservable construct. Rating scales are commonly used, but it is questionable whether others' observations of behaviors are related to the cognitive and attentional performance of children. A diverse sample of 54 children thought to have attention problems (children diagnosed with ADHD) and 28 nonpatient children without attention problems was gathered to obtain a sample across the continuum of attentional performance. The neuropsychological measures administered to children included continuous performance tests (CPTs) to measure sustained attention and divided attention, and Stroop and cancellation measures to measure selective attention. Parent rating scale measures included the Child Behavior Checklist, Conners' Parent Rating Scale, Child Attention Profile, and ADHD–IV Attention Scale. The most significant levels of convergence, with correlations ranging from .33 to .41 ($p < .01$), were found between the neuropsychological measure of sustained attention (CPT) and parent ratings of hyperactivity and impulsivity. This may have occurred because children with combined-type ADHD, and therefore those with symptoms of hyperactivity, were more impaired on the CPT than children diagnosed with predominantly inattentive-type ADHD and nonpatient controls. Neuropsychological and rating scale measures of attention had lower correlations. These findings indicate a need to re-evaluate rating scales of attention to determine whether they are related to the construct of attention, as opposed to the heterogeneous category "ADHD."
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B. SHENAL, S. HEATON, S. READER, & E.B. FENNELL. Differential Attentional Performance: A Case Comparison of Right and Left Thalamic Tumors in Two Adolescents.
Although there are a number of adult studies that describe attentional deficits associated with thalamic dysfunction, little is known about the differential role of the right and left thalamus in attentional functioning. Some recent studies link left thalamic functioning and attentional processing. However, the literature lacks a direct comparison of right and left thalamic contributions to attentional processing. Further, these studies do not address the multidimensional nature of attention. Two cases are presented to support a hypothesis of lateralized thalamic specialization for specific attentional dimensions in adolescents. Neuropsychological data is presented for a 15-year-old right-handed female with a history of a right thalamic tumor (RTT) and a 13-year-old right-handed male with a history of a left thalamic tumor (LTT). Both tumors were focal and noninvasive. Intellectual functioning was within the average range and comparable for the 2 cases. The RTT subject demonstrated more impaired visuospatial functioning while the LTT subject had greater verbal deficits. The Conners' Computerized Continuous Performance Test, Trails B, and the Test of Everyday Attention for Children were administered to assess selective, sustained, and controlled attention. The RTT subject demonstrated preserved sustained and controlled attention with relatively poorer selective attention. In contrast, the LTT subject demonstrated preserved selective and controlled attention with diminished performance on sustained attention tasks. Results are discussed in relation to past literature and current theories of attention. The discussion will highlight the importance of continued investigations of specific attentional dimensions.
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N. OJEDA, F. ORTUÑO, P. LÓPEZ GARCIA, J. ARBIZU LOSTAO, & S. CERVERA ENGUIX. The Contributions of the Parietal Lobes to Sustained Attention in Schizophrenia *vs.* Normal Controls: A PET Study.

Deficits in sustained attention are among the cognitive deficiencies more often described in schizophrenia. Previous functional neuroimaging studies have referred to the relation between the failure to maintain attention to stimuli in these patients and its neuroanatomical basis, including differences in levels of activation in the cingulate and prefrontal regions. The authors aimed to explore the full neuroanatomy underlying the attentional deficits observed in naive schizophrenic patients compare to normal controls. Ten healthy volunteers were studied. All subjects underwent medical screening, psychiatric interview, neurocognitive evaluation, and functional neuroimaging. The experimental design included 4 conditions: rest, auditory stimulation by using a series of clicks, and 2 counting tasks. First, subjects were instructed to mentally count the auditory clicks, and second count forward at an estimated frequency of 1 per second. Relative cerebral blood flow (relCBF) was measured by means of PET ^{15}O-water. Results in this investigation suggest that the functional neuroanatomy of sustained attention in schizophrenia also involves the parietal lobes bilaterally. The findings show a sustained attention network integrated by the anterior cingulate, dorsolateral prefrontal, and parietal cortical regions. The findings also support the hypothesis of abnormal activation of those auditory attentive pathways in schizophrenia.

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N.W. PARK, Z. HUSSAIN, & J.B. RICH. Full *vs.* Divided Attention Effects on Implicit and Explicit Retrieval of Words and Faces.

The mere exposure effect (MEE) refers to an increased evaluative preference for recently presented stimuli. We examined the effects of automatic and controlled processing on evaluative judgments of 32 neutral, novel faces among 24 healthy participants. The faces were presented with either a positive (e.g., polite) or negative (e.g., stingy) attribute. Presentation frequency (1 or 3) and attention (full or divided) were between-subject variables. Divided attention entailed repetitive, fast, finger tapping in a nonroutine sequence. Explicit memory was tested by yes/no recognition, and implicit memory was tested by evaluative judgments on a 9-point likability scale. Previously viewed faces were preferred relative to new faces, $F = 11.2$, $p < .01$. Valence significantly influenced evaluative judgments *only* under full attention with 3 presentations, $t = 3.7$, $p < .01$, but had no effect on recognition. In contrast, explicit memory increased significantly with increased exposure frequency, $F = 9.7$, $p < .01$, and was significantly higher in the full *versus* divided attention condition, $F = 11.7$, $p < .01$. In all 3 conditions where an MEE was obtained, processing of valence information at study had no effect on later evaluative judgments. Conversely, in the one condition where there was an effect of valence, the controlled processing overrode the MEE. Significantly, explicit memory was highest in this condition. Results support the idea that the MEE is mediated by processes that occur automatically and are not modified by controlled processes; that is, they appear to be informationally encapsulated.

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A. DAVIS & M. SEIDENBERG. Attention Biases in Attention Deficit Hyperactivity Disorder.

The current study examined hemispheric attention biases in children with attention deficit hyperactivity disorder (ADHD) who were medication-free *via* a global/local computer task. A total of 45 children between the ages of 7–14 participated in the study comprised of 3 groups: ADHD without a comorbid verbal learning disability (LD), ADHD with LD (ADHD LD), and a normal community sample (NC). Processing of global and local properties of a figure is associated with right and left posterior superior temporal-parietal regions, respectively (Robertson & Lamb, 1991). It was predicted that the ADHD group would fail to show a global processing advantage in the global-bias condition, but demonstrate a local advantage in the local-bias and no-bias conditions. The NC and ADHD LD groups were expected to show a global processing advantage in the global-bias condition, a local processing advantage in the local-bias condition, and no relative advantage in the no-bias condition. Additionally, the NC group was expected to be more accurate and demonstrate quicker reaction times on the task relative to the ADHD groups. Findings supported the hypotheses. Specifically, the ADHD group failed to show a global target advantage in the global-bias condition for both accuracy and reaction time data. Further, they showed a local target advantage in detection accuracy and speed for both the local-bias and no-bias conditions. The NC and ADHD LD groups both showed a global target advantage for accuracy and reaction time for both the global-bias and no-bias conditions. In the local-bias condition, both the NC and ADHD LD groups were quicker in detecting local targets, but only the NC group showed a local target advantage in accuracy detection. In addition, the NC group was more accurate than the ADHD groups, but contrary to predictions, slower in target detection.

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J. GITTEN, C. STERN, A. MARCOTTE, K. LOCKWOOD, W. HEINDEL, D. DOUGLAS, & M. BERGLEY A Multifactorial Study of Attention in Children with Attention Deficit Hyperactivity Disorder.

Introduction: In recent years, multi-component models of attention have gained acceptance in the fields of neuropsychology and cognitive psychology. While these models have been consistently applied to healthy populations, less is known about the applicability of these models to individuals with known attentional disorders, and in particular, children with attention deficit hyperactivity disorder (ADHD). *Participants:* The sample included 176 children (ages 6–12 years old) diagnosed with ADHD in the absence of any comorbid neurological, learning, or behavior disorders. No subject was on medication for treatment of attentional problems at the time of evaluation. *Method:* Fourteen neuropsychological variables were examined using a principal components analysis (PCA) with varimax rotation and pairwise exclusion of cases. Eigen-value was set at 1.0. *Results:* Three factors were identified based upon the results of the scree test from the initial PCA. The factor analysis was then re-run forcing 3 factors. Factor 1, labeled "Self-generated Organization," was comprised of the Rey Complex Figure (RCF)–copy, RCF–immediate recall, and total number of words produced for Verbal and Category Fluency. Factor 2, comprised of Digits Forward and Backward, was labeled "Span." Factor 3, "Sustaining," was comprised of indices derived from several measures sensitive to the relationship of speed and accuracy over time (cancellation and fluency tasks). *Conclusions:* This preliminary analysis lends support for a multifactorial model of attention. Results suggest that such a model may be extended to children diagnosed with ADHD.

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Y. FRANK, R. PERGOLIZZI, & M. PERILLA. Dopamine D4 Receptor Gene (D4RG) in Attention Deficit Hyperactivity Disorder (ADHD).

Cloninger et al. demonstrated independent heredibility of each of 4 basic dimensions of temperament: Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (P) in normal people (Cloninger, Svrakic, & Przybeck, 1993). NS individuals have high excitability, low frustration tolerance, are often impulsive, and engage in frequent exploratory activity—behaviors characteristic of ADHD. Higher than average NS scores were associated with a particular exonic polymorphism, the 7 repeat allele, in the locus for D4RG (Ebstein, 1996; Benjamin, 1996). In this study we investigated the relationship between D4RG polymorphism, temperament categories, and ADHD in 81 children with ADHD and 24 controls. Temperament categories were diagnosed using the Cloninger Junior Temperament and Character Inventory (JTCI) questionnaire. ADHD was diagnosed by a DSM–IV questionnaire (SNAP). DNA analysis for

D4RG was performed using Polymerase Chain Reaction (PCR). There was a significant correlation between SNAP–I and allele 1 (0.008), allele 2 (−0.049), and alleles 1,2 (0.001), and a weak correlation between SNAP–HI and allele 1 (−0.055); a weak positive correlation between allele 2 and TCI–NS (0.0651), a strong correlation between allele 2 and TCI–RD (0.0097) and a negative correlation between allele 2 and TCI–HA (−0.0818). A positive correlation was found between TCI–NS and SNAP–HI (0.45201; prob > 0.0179). Although preliminary, these results suggest a relationship between D4RG, ADHD, and temperament profiles.
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Paper Session 19/9:00–10:45 a.m.

HORMONES & COGNITION

K. MORDECAI, M. BELLANTONI, & P. MAKI. Cognition in Pre-*versus* Perimenopausal Women: Effects of Menopausal Symptoms.
Recent studies suggest that estrogen influences cognition in both pre- and post-menopausal women, but little is known about cognitive function during the perimenopausal transition. The aims of this study were to compare cognitive performance in pre- and perimenopausal women and to examine the relationship between menopausal symptoms and cognition. Participants were 145 volunteers in the Baltimore Longitudinal Study of Aging (BLSA), including 71 premenopausal (M age = 47 years) and 74 perimenopausal women (M age = 49) matched in education, mood, and general verbal abilities and who were not receiving exogenous hormones. The test battery included measures of verbal and figural memory, mental rotations, working memory, and attention. Test performance was similar between the groups, suggesting no general decrement in cognition among perimenopausal women. We next examined the relationship between menopausal symptoms and cognition in a subset of participants (28 pre- and 33 perimenopausal) who also completed a menopausal symptom questionnaire as part of the BLSA Perimenopausal Study. Factor analysis of the questionnaire revealed five factors, including mood and sleep disturbance, breast pain, hot flushes, urological symptoms, and sexual dysfunction. Menopausal symptoms differentially affected cognition in pre- and perimenopausal women. Specifically, among perimenopausal women only, mood and sleep factor scores correlated negatively with mental rotations performance ($r = -.66$, $p < .001$) and positively with figural memory errors ($r = .38$, $p = .02$). This suggests that certain menopausal symptoms might have a detrimental effect on cognition in women during the perimenopausal transition.
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S. BERNSTEIN, M. VARDY, J. NIEVES, J. CRUZ, K. FERRARA, B. LOWENSTEIN, M. ZION, S. GORDON, R. LINDSAY, & F. COSMAN. Short-Term Effects of Raloxifene, Tamoxifen, and Estrogen on Cognitive Function.
This randomized, double-blind, placebo-controlled study is the first head-to-head comparison of the short-term effects of raloxifene (RLX), tamoxifen (TAM), and conjugated equine estrogen (CEE) on cognitive function. *Method:* 103 healthy postmenopausal women were randomly assigned to receive TAM, 20 mg/day, RLX, 60 mg/day, CEE, 0.625 mg/day, or placebo (PBO). At baseline and during drug administration at 20 weeks, 96 participants completed neuropsychological testing and mood questionnaires. *Results:* Treatment groups did not differ in education, estimated IQ, or baseline cognitive or mood scores. However, the CEE group was significantly older than the RLX and TAM groups. There were no significant changes in mood scores in any group. In within-group cognitive analyses, TAM evidenced a significant worsening in score on an episodic verbal memory task and did not significantly improve on a visual learning task, whereas PBO, CEE, and RLX did. However, there was a trend toward a higher baseline score for the TAM group on this task. CEE and PBO improved significantly on a test of abstraction, whereas TAM and RLX's improvements were not significant. Finally, the RLX group improved significantly on a word recall task. Despite these within-group changes, however, between-group analyses, controlling for age, years from menopause, and baseline cognitive scores, revealed no significant differences between treatment groups over time on cognitive measures. *Conclusion:* Results do not reveal significant differences between CEE, RLX, or TAM, which appear to be generally neutral in their effects on cognitive function over a 20-week period.
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P. MAKI, S. DURSO, K. MORDECAI, J. BRANDT, & S. RESNICK. Hormone Therapy and Brain Function: A Cross-Over Trial in Elderly Women.
Hormone replacement therapy has been associated with improved verbal memory and a decreased risk of Alzheimer's disease in postmenopausal women. Animal studies point to the hippocampus as a possible target for such effects. The objective of this study was to determine whether hormone therapy influences brain activity during performance of a verbal memory task in elderly women. We hypothesized that hormone therapy would be associated with enhanced hippocampal activity. The study was a randomized, double-blind, placebo-controlled, crossover trial of 14 elderly cognitively normal women aged 66 to 86 [M (SD) age, 74.6 (6.56) years]. The intervention was a 90-day treatment of conjugated equine estrogens, .625 mg/d, plus medroxyprogesterone acetate, 2.5 mg/d, for nonhysterectomized women randomly crossed over with 90-day treatment of identical placebo. There was a 90-day washout between treatments. Positron emission tomography (PET) and 18-F fluorodeoxyglucose (18-F-FDG) were used to measure regional cerebral metabolic rate for glucose (rCMRglc) during performance of a verbal memory task. Hormone therapy was associated with increased regional glucose metabolism in the left middle/inferior temporal gyrus and left middle frontal gyrus and with decreased metabolism in the left posterior cingulate gyrus. Hormone therapy was also associated with enhanced short-term memory on a standardized neuropsychological test. These results bolster the biological plausibility that ovarian hormones may improve brain function in areas subserving verbal memory function in elderly women.
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D.A. YURGELUN-TODD, W.D.S. KILLGORE, & A.D. YOUNG. Gray and White Matter Volume During Adolescence Correlates With Cognitive Performance: A Morphometric MRI Study.
Recent studies using quantitative magnetic resonance imaging (MRI) have demonstrated that cerebral white (WM) and gray matter (GM) show different trajectories of growth during development, with WM volume increasing linearly until the 3rd to 5th decades and then declining into late adulthood, while GM volume peaks in early adolescence and thereafter declines slowly over the lifespan. Despite the marked changes in cerebral structure and organization occurring during adolescence, there is only limited data regarding the relationship between specific cognitive abilities and volumetric measures of GM and WM in this group. In the present study, we correlated performances on a battery of neurocognitive tests with morphometric MRI volumes (corrected for whole brain volume) of WM, GM, and cerebrospinal fluid in a sample of 38 adolescents (14 male; 24 female), ranging in age from 12 to 17 years (M = 14.6, SD = 1.5). Structural neuroimaging was performed on a 1.5 Tesla scanner, using T1 weighted coronal images of the whole brain. Tissue boundaries were drawn by a trained operator using a semi-automated segmentation algorithm. Correlational analysis revealed significant positive associations (ps < .05) between WM volume and stronger performance on a number of neurocognitive measures assessing attention, working memory, psychomotor

speed, verbal intelligence, executive control, and academic abilities. Conversely, larger volumes of GM were uniformly associated with poorer performance on these same tasks ($ps < .05$). We conclude that the changes in the ratio of WM to GM that occur during adolescence are significantly related to measurable differences in neurocognitive performance.
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C. SAVAGE, B. SHERMAN, K. EDDY, C. CONNOR, M. BLAIS, T. DECKERSBACH, S. RAUCH, & D. HERZOG. Are Strategic Memory Deficits in Anorexia Nervosa Similar to Those Found in OCD?
There is growing interest in relationships between anorexia nervosa (AN) and obsessive-compulsive disorder (OCD). For instance, family incidence studies show significant familial associations between AN and OCD. Neuropsychological investigations in OCD have found problems with the efficient use of strategy on complex measures of learning and memory. This study evaluated nonverbal strategic memory in a patient group with AN using an approach previously applied to OCD. Eighteen patients with AN were compared to 19 matched healthy control subjects. Participants were given the Rey-Osterrieth Complex Figure Test (RCFT), a widely used measure of nonverbal strategic planning, learning, and memory. Measures of interest, including accuracy and organizational planning scores, were subjected to planned comparisons with ANOVA and multiple regression. AN patients differed significantly from healthy controls in the organizational strategies used to copy the RCFT figure ($p = .01$), and they recalled significantly less information on both immediate ($p = .001$) and delayed ($p = .0001$) testing. Multiple regression analyses indicated that group differences in learning (immediate percent recall) were statistically mediated by copy organizational strategies ($\Delta R^2 = .20$, $p < .01$). These results are identical to findings in previous OCD studies. The essential cognitive deficit was impaired use of organizational strategies, which affected how much information was encoded and retrieved from memory. Our results are consistent with "OC spectrum" hypotheses concerning AN and indicate that OCD and AN share important neuropsychological features. Future studies are needed to replicate and extend findings to other domains of neuropsychological functioning.
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K. LOKKEN & F.R. FERRARO. Specific Executive Function Impairment Among Women With Bulimic Symptomatology.
There is evidence that women diagnosed with bulimia nervosa are characteristically impulsive and demonstrate executive functioning deficits on neuropsychological tasks. Of interest is whether a sample of nonclinical women reporting bulimic attitudes and behaviors would show similar patterns of neuropsychological performance. The present study compared the performances of 30 nonclinical women reporting bulimic symptoms to 30 matched control women reporting few or no bulimic symptoms on a battery of neuropsychological tests sensitive to executive dysfunction. Presence of bulimic symptomatology was assessed by the Bulimia Test–Revised (BULIT–R). The 2 groups were matched on variables such as sex, age, education level, handedness, and vocabulary knowledge. A principle components analysis was used to reduce the rather large number of executive functioning variables, and a composite executive functioning measure was derived. Using analysis of variance (ANOVA), the results indicated that overall, women with bulimic symptoms performed more poorly on measures of executive function, relative to women reporting minimal or no bulimic symptoms [$F(1,59) = 5.59$, $p < .05$]. The findings provide support for the role of neuropsychological assessment in the characterization of bulimic individuals, and may give credence to the notion of frontal lobe involvement in the nosology of bulimia nervosa.
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R. ZEC, M. TRIVEDI, S. MARKWELL, R. STRUBLE, & L. HUGHES. Effects of Estrogen Replacement Therapy on Cognition in Post-Menopausal Women.
The effect of estrogen replacement therapy (ERT) on a comprehensive series of cognitive tests was examined in healthy post-menopausal women. Four groups of women were compared: never users ($n = 71$), past users ($n = 28$), present users ($n = 60$), and future users ($n = 20$) (i.e., women not taking ERT at the initial cognitive evaluation, but who later began using ERT). There was no significant difference among the 4 groups in years of education (M range 14.2 to 15.3 years for the 4 groups). The never user group was significantly older than the present and future user groups, and so an ANCOVA was performed using age as a co-variate. The test series measured all major cognitive domains, e.g., new learning and memory, attention, timed psychomotor performance, confrontational and generative naming, visuospatial skills, and problem solving. The ANCOVAs revealed 4 significant findings out of 87 total variables ($p < .01$), including 3 semantic word fluency measures and the WAIS–R picture completion subtest. In each case, follow-up tests revealed that past users performed significantly better than the other 3 groups. In conclusion, contrary to the extant literature, the present user group did not perform significantly better on any of the test variables compared to the other groups. The findings that past users performed better on several cognitive measures raises the possibility that there might be a critical period during the early post-menopausal years when ERT might have a permanent effect on the brain, such that the beneficial effects are measurable many years after ERT has been stopped.
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Symposium 15/9:00–10:45 a.m.

NEUROPSYCHOLOGY OF HIV: FROM PHENOMENOLOGY TO MECHANISMS AND OUTCOMES

Organizer and Chair: Igor Grant

I. GRANT. Neuropsychology of HIV: From Phenomenology to Mechanisms and Outcomes.
The first cases of AIDS were reported in 1981, and neurological complications were noted soon thereafter. This symposium reviews progress that has taken place toward understanding the neurobiologic bases and consequences of neuroAIDS in the 15 years since publication of the first study that described the neuropsychology of HIV at various disease stages (Grant et al., 1987). In his introductory comments the Symposium Organizer (Grant) will overview the neuropsychological (NP) phenomenology of HIV. The first paper (Cherner et al.) will describe the neural injury that has been observed in the brains of those dying with HIV, and link these to *ante mortem* NP changes in the same subjects to demonstrate that in-life NP decline has discrete neuropathologic underpinnings. The second paper (Taylor) reports on the combined insult of methamphetamine abuse and HIV infection on brain function, from studies involving both NP and MR spectroscopic methods. The third paper (Rivera-Mindt) demonstrates the relationship between NP and HIV concentration in the cerebrospinal fluid, which may serve as a window into CNS events. This paper also describes the effects of antiviral treatments on both HIV concentration and NP. The fourth paper (Heaton) links NP and virologic indicators to real life functioning, including measures of activities of daily living and driving. The discussants will critique the studies presented, and propose directions for further research. Beyond providing attendees with new information on NP of HIV, the symposium emphasizes a model of NP research that takes advantage of multidisciplinary collaborations to illuminate the neurobio-

logic underpinnings, as well as the practical implications of NP observations, both in terms of treatment and everyday functioning.
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M. CHERNER, D. MOORE, E. MASLIAH, R. ELLIS, R.K. HEATON, I. GRANT, & THE HNRC GROUP. Relationship Between Neuropsychological Impairment and Post-Mortem Findings of HIV-Associated Brain Disease.

Previous work in neuroAIDS has yielded inconsistent findings on the relationship between cognitive deficits and neuropathology. Recent examination of clinico-pathologic correlations suggests that *ante mortem* neuropsychological impairment is a highly specific indicator of HIV-related brain disease. Evidence of HIV encephalitis (HIVE) and neurodegenerative changes were determined in 39 HIV seropositive study participants who had been assessed during life with a comprehensive neuropsychological (NP) battery. Cognitive impairment was determined using blind clinical ratings based on demographically corrected NP test scores. Presence of HIVE was based on post-mortem immunocytochemical detection of the viral envelope protein gp41 or by Amplicor HIV PCR in multiple brain areas, as well as by histopathologic evidence, such as microgliosis, presence of multinucleated giant cells, and myelin pallor in several brain regions. Neurodegenerative changes evidenced by dendritic simplification were measured as the area of neuropil covered by microtubule associated protein 2 (MAP2) immunoreactive dendrites in a number of brain areas. Presence of neurocognitive impairment in life was almost always predictive of HIVE, whether or not frank neurodegeneration was evident. Among 18 Ss with NP impairment, 17 (94%) had HIVE, compared to 42% of NP normals, and 78% had both HIVE and neurodegeneration, compared to 19% of normals. Results suggest that if cognitive impairment is detected, there is a very strong likelihood that HIV related changes will be manifest in brain tissue. Information about neuropsychological status can be an important tool to help select HIV+ patients for pharmacologic treatments that target the central nervous system.
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M. J. TAYLOR, B.C. SCHWEINSBURG, O.M. ALHASSOON, G.G. BROWN, R.K. HEATON, I. GRANT, & THE HNRC GROUP. Concordance of MR Spectroscopic and Neuropsychological Deficits in HIV and Methamphetamine Dependence.

The aim of this study was to evaluate the impact of HIV, methamphetamine dependence, and their combined effects on fronto-striatal regional brain metabolites using proton magnetic resonance spectroscopy (MRS) and to determine the extent to which HIV and methamphetamine-associated changes in brain metabolites are related to concurrent changes in neuropsychological functioning. Participants from the following groups were assessed using short-echo PRESS MRS: (1) HIV seronegative nondrug users (HIV-/Meth-, $n = 23$); (2) HIV seronegative methamphetamine users (HIV-/Meth+, $n = 40$); (3) HIV seropositive nondrug users (HIV+/Meth-, $n = 34$); and (4) HIV seropositive methamphetamine users (HIV+/Meth+, $n = 22$). Groups were equated on age and level of illness in the HIV+ groups. Metabolites including *N*-acetylaspartate (NAA), a marker of neuronal integrity, were measured in the right frontal white matter, midline frontal gray matter, and right caudate nucleus. Two by two ANOVAs (HIV status by methamphetamine status) with metabolites as the dependent variables revealed significantly lower relative amounts of NAA in the frontal white matter of HIV+ subjects regardless of their drug status, $F(1,108) = 4.33$, $p = .04$. A similar trend was present in the frontal gray matter, but not the caudate. Lower levels of NAA in frontal gray matter were significantly related to poorer abstraction ability, $r = -0.26$, $p = 0.04$. Reduced NAA in the frontal white matter was related to poorer attention, $r = -0.25$, $p = .02$. In addition, lower NAA levels in the frontal white matter and caudate nucleus were associated with poorer complex perceptual motor functioning, $r = -0.23$, $p = .04$, and $r = -0.22$, $p = .05$, respectively. The data are consistent with the hypothesis that HIV produces damage to fronto-striatal pathways measured at both the molecular and neurobehavioral level.
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M. RIVERA MINDT, R. ELLIS, D. J. MOORE, R.K. HEATON, R. DEUTSCH, I. GRANT, & THE HNRC GROUP. The Roles of HIV RNA Viral Load and Highly Active Antiretroviral Treatment (HAART) in Incident HIV-Associated Neuropsychological Impairment.

Previous cross-sectional studies indicate that HIV-associated neuropsychological (NP) impairment is related to elevated HIV RNA in cerebrospinal fluid (CSF), but not blood plasma. Although HAART has improved immune function in many HIV+ individuals, milder neurocognitive dysfunction often persists, possibly due to poor penetration of some antiretroviral agents into the CNS. *Objectives:* We performed 2 studies to evaluate whether elevated CSF HIV RNA predicts subsequent NP decline (Study 1), and whether changes in incident NP impairment have occurred since the introduction of HAART (Study 2). *Methods:* All subjects were HIV+, rated NP normal at baseline, and part of a larger prospective, longitudinal cohort study. HAART was prescribed at the discretion of the subjects' primary care physicians. Comprehensive NP and neuromedical evaluations were performed at initial and follow-up visits, at least 6 months apart. Study 1 ($N = 94$) included participants at varying stages of HIV disease. Study 2 ($N = 46$) was restricted to persons at high risk for developing NP impairment, i.e., those with CDC stage C HIV disease. *Results:* In Study 1, higher HIV RNA CSF at baseline predicted a higher risk of incident NP impairment at follow-up. However, plasma HIV RNA did not predict subsequent impairment. Study 2 revealed that twice as many participants (36%) in the pre-HAART group developed NP impairment than in the post-HAART group (17%), and incident NP impairment occurred significantly sooner in the pre-HAART cohort. *Conclusions:* Taken together, the results suggest that HIV RNA in CSF predicts incident NP impairment, while HAART protects from subsequent NP impairment.
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R.K. HEATON, M. RIVERA MINDT, T. MARCOTTE, D. J. MOORE, K. WEINBERG, I. GRANT, & THE HNRC GROUP. The Functional Impact of HIV-Associated Neuropsychological Impairment: A Longitudinal Study.

Previous research indicates that HIV-associated neuropsychological (NP) impairment is associated with higher rates of unemployment, poorer vocational abilities, and increased dependence in activities of daily living (ADLs); however, the temporal nature of these relationships is unclear. In this study we assessed whether changes in NP status in HIV+ subjects were associated with changes in performance on laboratory based measures of ADLs and vocational functioning. *Methods:* 236 HIV+ subjects participated in a longitudinal study involving comprehensive neuromedical, NP, and functional status evaluations. Thirty-two individuals were classified as NP-improved and 32 as NP-declined across visits at least 6 months apart; these groups were equivalent on baseline NP and functional status. *Results:* At Time 2, NP decliners performed worse on measures of financial management ($p < .05$) and medication management ($p = .10$), as well as on a summary measure of overall functional ability ($p < .05$). The groups were not significantly different on other individual functional measures at Time 2 (i.e., cooking, restaurant scenario, shopping, and vocational ability). Functionally impaired subjects had worse NP status and higher plasma HIV RNA viral load at both visits, but multiple regression analysis revealed that only initial NP status predicted functional impairment at Time 2. CD4 count and depression (Beck Depression Inventory) were not predictive of functional impairment at either time. *Conclusions:* Although preliminary, these findings suggest that both NP and neuromedical status are associated with objective evidence of functional impair-

ment; however, NP status appears to be the most robust predictor of functional impairment over time.
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Symposium 16/9:00–10:45 a.m.

CHILDREN'S ANGER AND AGGRESSION: OVERVIEWS, ISSUES AND IMPLICATIONS FOR NEUROPSYCHOLOGICAL PRACTICE

Organizer: Michael Potegal
Chair: Robert M. Gray

R. GRAY, K. McBURNETT, J. NIGG, M. POTEGAL, & R. TREMBLAY. Children's Anger and Aggression: Overviews, Issues and Implications for Neuropsychological Practice.
Children engaging in disruptive, oppositional, aggressive, and antisocial behaviors generally suffer from significant psychological and social impairment in their own lives. Their behaviors also result in significant, multigenerational costs to society in general. The last 50 years has seen a rapid expansion in multidisciplinary research describing the epidemiology, etiology, subtypes, neuropsychology, neurobiology, life course, and treatment of childhood aggression and antisocial behavior. This symposium presentation will review major theoretical/etiological issues in childhood aggression from a variety of perspectives and discuss the relevance of this information for the child/pediatric neuropsychologist who is often confronted with referrals of children who are aggressive and antisocial. Richard Tremblay will discuss his extensive research investigating developmental trajectories of physical aggression over the first 4 years of life. Michael Potegal will review his research on the time course and behavioral composition of children's temper tantrums and discuss how tantrums may inform us about the development of childhood emotional and anger regulation. Keith McBurnett will review prior research which associates verbal skill deficits and childhood aggression and he will also present new data lending support to this putative association. Finally, Robert Gray will use a case study format to emphasize how multidisciplinary research findings in the area of childhood aggression can be integrated into the clinical neuropsychological assessment. Serving as discussant, Joel Nigg will comment on issues of differential diagnostic considerations and conditions that are comorbid with childhood conduct problems.
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M. POTEGAL. Temper Tantrums in Typical and Psychopathological Development.
Epidemiologically, tantrums are among the most commonly reported behavioral problems of young children. Clinically, tantrums persisting to age 8 significantly predict boys' future antisocial psychopathology. Theoretically, tantrums are a window onto emotions so intense as to be otherwise unavailable to systematic observation. Our long-term research program, including the study of tantrums' neural bases and autonomic physiology, ontogeny and development, dynamics, and relationships to child temperament and parental intervention, is intended to foster the understanding of both researchers and practitioners with regard to the role of tantrums in typical *versus* psychopathological development. To date, multidimensional scaling and factor analyses of 335 tantrum narratives provided by parents has indicated that tantrums consist of 2 main emotional/behavioral processes. Anger-related behaviors, e.g., shouting, hitting, kicking, stamping, or throwing, are maximal at or near tantrum onset and decline relatively rapidly over the course of the tantrum. The probability of distress-related crying, whining, and comfort-seeking tends to increase through the tantrum. Further evidence for the separability of anger and distress comes from our EEG study of hemisphere asymmetries in tantrum prone and nontantrum prone 4-year-olds in which right frontal cortex activation correlated significantly with facial expressions of sadness while left temporal activation was associated with both parental reports and laboratory measures of anger. We will also briefly note results available at the time of this presentation from ongoing studies of tantrum-associated cortisol shifts in 3-year-olds and from comparisons of the tantrums of externalizing *versus* internalizing 4-year-olds.
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K. McBURNETT. Neuropsychology of Early Aggression.
Psychologists have long known that mild cognitive impairment is associated with aggression and delinquency in adolescents. On average, juvenile delinquents score $\frac{1}{2}$ *SD* below normals on verbal IQ. The relationship between these subtle deficits and the behavior problems that precede delinquency is not clear (whether one causes the other, or whether both are correlated without causal connection). Verbal deficits could contribute to school failure (a risk for delinquency). On the other hand, the delinquent lifestyle is marked by greater-than-average head trauma and substance abuse, thus delinquent behavior could contribute to lowered VIQ. Another complication is the bias that preferentially selects less intelligent youth for apprehension by police and adjudication by the courts. These questions cannot be resolved experimentally, and neither antisocial behavior nor verbal impairment can be assigned experimentally. Insight can be gathered from longitudinal studies. Unexpectedly, the most recent longitudinal data suggest the lower visual-spatial abilities, not lower verbal skills, place young children at risk for later antisocial behavior. A comprehensive view of the relationship of neuropsychological functions and aggression must take subtyping into account. Research on child conduct disorder shows that early onset aggression is a different syndrome from adolescent-onset offending. Another moderating factor is the comorbidity of ADHD, which is believed to involve frontal-executive dysfunction. This talk presents new data using multiple measures of verbal skills (Boston Naming Test, Wechsler VIQ) showing that early onset aggression is associated with mild deficits in verbal skills. A critical and integrated review of previous research in this area will be presented.
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R. GRAY. Case Studies in Childhood Conduct Disorder.
A case study format is used to illustrate the integration of multidisciplinary research findings in the area of childhood aggression into clinical pediatric neuropsychological practice. Childhood aggression is currently conceptualized as multiply determined and as heterogeneous in nature with several subtypes identified. An understanding of the multiple causal pathways, developmental trajectories, and of the variations in the quality and range of aggressive behaviors and comorbid conditions, becomes important for case conceptualization, assessment and treatment planning. Case 1 is an example of a child who demonstrates a history and neuropsychological pattern of performance consistent with an early onset, persistent, "reactive," "overt" subtype of conduct disorder, while Case 2 demonstrates an historical, behavioral, and neuropsychological pattern more consistent with a "covert," "proactive," callous and unemotional subtype of conduct disorder. Relevant historical, psychosocial, and neuropsychological information regarding the 2 children will be reviewed, compared, and contrasted with an emphasis on delineating assessment objectives and strategies that can be employed by the practicing pediatric neuropsychologist.
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R. TREMBLAY. The Development of Physical Aggression During Early Childhood.
Since most of the 20th century, work on the development of aggression was concentrated on adolescents and elementary school age children, there

appeared to be an implicit assumption that aggression is learned during these developmental periods. However, the form of aggressive behavior which is generally considered more "serious" or "socially unacceptable," physical aggression, is clearly ontogenetically antecedent to less "serious" forms of aggressive behavior, such as verbal aggression or indirect aggression. Furthermore, as a rule, the frequency of physical aggression appears to decrease with age. This paper will present a longitudinal research program on the development of physical aggression during the first 4 years after birth. Large twin and singleton samples were used to assess the early developmental trajectories of physical aggression and the biopsychosocial determinants of these trajectories.
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Paper Session 20/11:00 a.m.–12:45 p.m.

PARKINSON'S AND OTHER DISEASES

M. BARNES & M. WILKINSON. Math Fact Retrieval in Good Readers With Spina Bifida: Speed and Strategy Choice.
Children with spina bifida and hydrocephalus (SBH) have difficulty with several aspects of mathematics, including calculation. We investigated the integrity of a basic component of arithmetic processing, the efficiency of number fact computation. Thirty-one good readers with SBH were matched to 31 controls for age (means of 11.3 and 11.1 years), grade, and word decoding ability. Single digit addition problems (e.g., 3 + 5) were presented one at a time on a computer screen. The participant spoke the answer as quickly, but as accurately as possible. Computation strategy was coded from examiner observation during each trial, and from child self-report immediately following each trial. The SBH and control groups were equally accurate on calculation of addition facts; their reporting of their strategy use was highly consistent with that observed by the examiner; and the groups used different strategies such as direct memory retrieval and counting up from the largest digit, with the same frequency. However, the SBH group was slower, even on those trials in which they retrieved the answer directly from semantic memory rather than through the use of other computation strategies. The results are compatible with the view that a lack of automaticity in basic components of arithmetic processing may constrain the later development of more complex calculation procedures in children with SBH. Because SBH is a condition in which basic deficits in math fact retrieval are not accompanied by difficulties in word decoding, the data bear on recent models of math disability.
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C.L. ARMSTRONG, J.V. HUNTER, G.E. LEDAKIS, B. GOLDSTEIN, B. COHEN, E. SCHAFER, Z. TOCHNER, & R. LUSTIG. Late Cognitive and Radiographic Changes Related to Radiotherapy.
Assumptions about the damaging effects of radiotherapy (XRT) are based on studies in which total dose, dose fraction, degree of malignancy, chemotherapy, tumor recurrence, and other neurological comorbidity interact with XRT effects. We present a prospective, long-term study of XRT effects in adults with low-grade, supratentorial, brain tumors. In this study, total dose and dose fraction are highly constrained, and we excluded data related to tumor recurrence and comorbid disease that potentially affects neurological status (e.g., hypertension). Cognitive and radiographic outcomes from baseline (6 weeks post surgery and immediately prior to XRT) and yearly for 6 years were examined in both group and individual analyses. Selective cognitive decline (in visual memory) emerged only at the 5 year endpoint. Ratings of clinical MRIs (T2 images) show mild accumulation of hyperintensities with post treatment onset from 6 months to 3 years and with no further progression. The MRI evidence was mild white matter atrophy and a mild degree of total hyperintensities with subcortical and deep white matter, corpus callosum, cerebellar structures, and pons demonstrating these changes over time. About half of the patients had the cognitive decline and treatment-related hyperintensities. There was no evidence of a general cognitive decline or progression of white matter changes after 3 years. Results argue for limited damage from XRT in the absence of other clinical risk factors for white matter changes on MRI and cognitive decline. Findings are discussed in relation to possible neuropathological mechanisms.
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J.V. FILOTEO, F. J. FRIEDRICH, L.M. RILLING, J.D. DAVIS, J.L. STRICKER, & M. PRENOVITZ. Word Priming in Patients with Parkinson's Disease.
Semantic and cross-case identity priming were investigated in nondemented patients with Parkinson's disease (PD) and controls using the Lexical Decision Task. Three conditions were administered that consisted of the presentation of prime and probe word pairs. In the semantic priming condition the word pairs were semantically related (e.g., table-CHAIR), in the cross case priming condition the word pairs consisted of the same word (e.g., noise-NOISE), and in the unrelated condition the word pairs were not related semantically (e.g., guns-DEEP). A fourth condition was also administered that consisted of the presentation of a prime word and a probe nonword (e.g., starved-LAJV). Participants were asked to indicate whether the prime was a word or nonword. The prime and probe were separated by either a short or long (200 ms or 800 ms) stimulus onset asynchrony (SOA). Results indicated that PD patients displayed normal semantic priming (i.e., faster responding to the probe in the semantic condition as compared to the unrelated condition) at both the short and long SOA. Similarly, PD patients displayed normal cross-case identity priming (i.e., faster responding to the probe in the cross-case condition relative to the unrelated condition) at the long SOA. At the short SOA, however, PD patients displayed hyper cross-case priming relative to controls (134 ms *vs.* 50 ms). These results suggest that semantic processes are normal in nondemented PD patients, but that the processes involved in accessing lexical information may be overly activated in these patients.
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D. J. SCHRETLEN, L. KERENYI, J.M. LILYESTROM, G.A. RICAURTE, U. McCANN, A. ALEKSIC, W.B. MATTHEWS, & Z. SZABO. Clinical Correlates of Dopamine and Serotonin Transporter Binding in PD.
Previous studies have demonstrated reductions of both dopamine and serotonin in the basal ganglia and other brain regions among patients with Parkinson's disease (PD). The contribution of dopamine depletion to motor abnormalities is well documented, but the effects of serotonin depletion remain unclear. Here we used positron emission tomography (PET) to examine dopamine (DAT) and serotonin (SERT) transporter binding in the caudate nucleus (CN) and putamen (PUT) in 13 patients with PD and 13 normal adults. The groups did not differ in age, sex, education, or estimated IQ. Two PET studies, using [^{11}C]WIN35.428 to assess DAT and [^{11}C](+)McN5652 to assess SERT, were conducted on each subject, and images were co-registered with MRI to define regions of interest/cerebellum binding ratios. Multivariate ANOVA revealed that DAT and SERT binding were significantly lower in PD than NC participants. In the CN and PUT, respectively, DAT binding correlated with Hoehn-Yahr disease severity ratings (H-Y rs = −.58, −.74), Unified Parkinson's Disease Rating Scale scores (UPDRS rs = −.47, −.68) activities of daily living (ADL rs = −.43, −.60), and Grooved Pegboard performance (GPT rs = −.59, −.71) but not with Geriatric Depression Scale (GDS) scores. Conversely, SERT binding correlated significantly with the GDS (rs = −.46,

−.46), H-Y (*r*s = −.41, −.46), and GPT (*r*s = −.63, −.60), but not with UPDRS or ADL ratings. These results suggest that reduced dopamine and serotonin binding both correlate with overall disease severity, but make partially distinct contributions to other clinical features of Parkinson's disease.

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B. BUTLER, E. HARRISON, A. McDONALD, & G. ESKES. Gradient of Detection in Neglect: Comparing Peripersonal and Extrapersonal Space.

Hemispatial neglect can be considered a deficit in directing attention/movement toward contralesional space. Target-detection performance in neglect was reported to show a linear decrease in the number of targets detected from right to left (Halligan & Marshall, 1994). The purpose of the present study was to replicate the reported attentional gradient in peripersonal space (within arms reach) and examine whether a gradient also appears in extrapersonal space (beyond arms reach). Neglect subjects ($n = 7$), right-hemisphere damaged nonneglect controls ($n = 10$), and healthy controls ($n = 8$) identified visual targets amidst distractors in peripersonal and extrapersonal space. Targets (numbers and capital letters) were pseudo-randomly distributed on a scanning sheet such that 6 different targets appeared in each of 8 columns of an imaginary grid and no target was repeated on a single sheet. Performance on this experimental scanning task in peripersonal and extrapersonal space was significantly positively correlated with standardized neuropsychological tests of neglect, indicating the validity of this test as a measure. The neglect group showed similar gradients of decreasing target detection from right to left in both peripersonal and extrapersonal space, which were not evident in either of the control groups ($p < .05$). A potential dissociation of neglect in peripersonal and extrapersonal space was noted in one participant based on statistical analyses of individual's scanning performance across columns in each space. The results are discussed in terms of the neural circuitry of visuospatial attention in peripersonal and extrapersonal space.

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A.M. BARRETT, E. LONGIN, & K. HEILMAN. Monocular Patching Affects Inattention But Not Perseveration in Spatial Neglect.

Ipsilesional eye patching has been proposed as a treatment for unilateral spatial neglect. We wished to learn if a monocular patch would improve performance in a patient with chronic neglect after right temporal-occipital stroke. We hypothesized that patching would improve perceptual-attentional, not motor-intentional deficits. The patient failed to cancel lines in left space (omissions) and repeatedly canceled lines in right space (perseverations). We dissociated action-space from video feedback using a video apparatus by right-left reversing the workspace. This procedure allowed us to discriminate attentional from intentional bias. We found that omission errors were consistent with an underlying perceptual-attentional deficit and perseverative errors were consistent with a motor-intentional bias. Contralesional (left) eye patching had no effect on the asymmetry of omission errors ($p = 0.871$). Ipsilesional eye patching, however, reduced omission errors in left *versus* right space compared with the unpatched condition ($p = 0.016$). There was no significant effect of contralesional ($p = 0.334$) or ipsilesional ($p = 0.289$) eye patching on the asymmetry of perseverative errors. These results suggest that clinicians treating spatial neglect may obtain best results by tailoring therapies to the character of their patients' deficits.

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R. SCHEIBEL & C. MEYERS. Cognitive Dysfunction Associated With Interferon Alpha and Chemotherapy.

Cognitive dysfunction has been reported to be a side effect of interferon alpha (IFN-α). However, most trials did not obtain pretreatment data and some found no cognitive impairment. The current study examined 30 adults receiving IFN-α for chronic myelogenous leukemia. Assessments were conducted before and during *FN-*α treatment using Digit Symbol (DS), the Controlled Oral Word Association Test (COWAT), Trail Making Test (TMT) Parts A and B, and consistent long-term retrieval (CLTR) and delayed recall from the Verbal Selective Reminding Test. Normative data were used to convert raw scores to *T* scores. Because 17 patients also received cytosine arabinoside or hydroxyurea, data were analyzed using a mixed design examining Time (pretreatment *vs.* on-treatment) and Protocol (IFN-α alone *vs.* combination therapy). Declines were found between baseline and on-treatment assessments for DS ($M_1 = 53.4$, $SD_1 = 5.9$; $M_2 = 51.3$, $SD_2 = 7.2$; $p < .027$) and TMT Part B ($M_1 = 52.9$, $SD_1 = 13.5$; $M_2 = 45.1$, $SD_2 = 17.0$; $p < .009$), but these did not have a significant Time × Protocol interaction. An interaction was found for COWAT ($p < .008$) and CLTR ($p < .030$). Planned comparisons revealed declines for patients on combination protocols for COWAT ($M_1 = 55.7$, $SD_1 = 7.3$; $M_2 = 48.9$, $SD_2 = 12.2$; $p < .009$) and CLTR ($M_1 = 36.2$, $SD_1 = 9.8$; $M_2 = 25.0$, $SD_2 = 13.0$; $p < .004$). These findings are consistent with cognitive decline during IFN-α treatment, multiple impairment patterns, and greater impairment with combination therapy.

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Paper Session 21/11:00–12:45 p.m.

LATERALITY, COGNITION AND fMRI

D.S. SABSEVITZ, S.J. SWANSON, T.A. HAMMEKE, E.T. POSSING, M.V. SPANAKI, G.L. MORRIS, W.M. MUELLER, & J.R. BINDER. Predicting Naming Deficits Following Left Anterior Temporal Lobectomy Using fMRI.

Left anterior temporal lobectomy (L-ATL) may be complicated by confrontation naming deficits. The goal of the present study was to determine whether preoperative functional magnetic resonance imaging (fMRI) could be used to predict naming impairments following L-ATL in epilepsy patients. Twenty-one L-ATL patients who underwent preoperative fMRI and pre- and 6 month postoperative neuropsychological testing were examined. In the fMRI study, activation during an auditory single-word semantic decision task was compared to a tone perception control task. Normative studies from our lab showed activation in a number of temporal lobe (TL) regions with this task. A region of interest (ROI) was created that included anterior lateral TL, medial TL, and posterior TL. A laterality index (LI) was calculated using the left-right difference in number of activated voxels in this ROI, corrected for the total volume of activity in the entire brain. Analyses showed a significant relationship between Boston Naming Test (BNT) outcome (post–pre) and the LI ($r = -.54$, $p < .02$). That is, greater preoperative activation in the operated (left) TL relative to the right TL was related to greater decline on the BNT. Greater activation in the left-sided ROI alone was also related to poorer BNT outcome ($r = -.51$, $p < .02$). Greater activation in the unoperated side was associated with better naming outcome ($r = .46$, $p < .05$). Also of interest, fMRI activation in the left ROI was significantly correlated with preoperative BNT performance ($r = .49$, $p < .02$). These results suggest that fMRI may aid in predicting cognitive outcome following L-ATL.

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J.D. CAREW, V.M. HAUGHTON, K. ARFANAKIS, B.P. HERMANN, C. MORITZ, & M.E. MEYERAND. An fMRI Adaptation of the Wada Test of Memory.

The Wada test is used to determine cerebral dominance for language and memory capacity in each hemisphere in candidates for anterior temporal lobectomy. The purpose of this study was to determine the location of fMRI activation in normal volunteers performing the Medical College of

Georgia modification of the memory component of the Wada test, modified for application in the MR scanner. The task included periods of rest and periods in which images of objects were presented to 9 subjects. The subjects were asked to remember the 8 target objects and to respond when prompted with an object had been seen previously in recognition testing. Statistical parametric mapping was used to infer fMRI activation. In 2 trials on 8 subjects, task activation was identified in the visual cortex, fusiform gyrus, and posterior parahippocampus bilaterally. With the techniques used and thresholds selected, activation was not consistently identified in the anterior hippocampus. One subject was excluded due to uncorrectable motion. This investigation demonstrates that the traditional Wada test memory procedure activates bilateral mesial temporal regions as proposed. Further studies are needed to determine if the anterior hippocampus is activated concurrently with the posterior hippocampus and parahippocampal gyrus during the Wada test and to determine if lateralized mesial temporal lobe epilepsy results in unilateral memory impairment on the fMRI Wada test as in the conventional Wada Testing.
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R.M. LAZAR, R.S. MARSHALL, R.S. BAGGA, R.J. SATTENBERG, & J. PILE-SPELLMAN. Verbal Memory Loss Following Superselective Wada Testing in Right Cerebral AVM.
A risk of treating cerebral AVMs is whether lesions lie in eloquent regions. We have shown with selective anesthetic injections that language has an unusual distribution with left cerebral AVM. Our aim here was to determine if superselective WADA testing in right-hemisphere arteries would produce verbal memory loss in patients with right cerebral AVM. Thirty-six patients, 31 right- and 5 left-handed, had injections of amobarbital sodium plus lidocaine into 104 vessels near or feeding right AVMs, with 28 ACA, 20 MCA, and 55 PCA feeders. Memory testing occurred at baseline, 1 min after anesthetic injection, and 12 min after injection. Memory tests consisted of 5 words presented to the patient. After 3 min, recall was tested: maximum score was 15, with uncued recall of a word = 3 points, prompted recall = 2 points, and multiple choice = 1 point. There was no statistical change from baseline to anesthetic testing in 76% of the tested vessels. In 24% of the vessels, involving 16/36 patients, there was at least 1 vessel feeding the AVM in which there was significant verbal memory loss. In these instances, the mean memory score at baseline was 14.3 (SD = 1.1). Following injection of anesthetics, the mean score fell significantly to 8.5 (t test, $p < .00001$). Attention was unaltered. Memory returned to baseline levels at 12 min. Traditional assumptions about eloquent regions would have suggested such testing as unnecessary, but embolization here would have yielded significant morbidity. Our findings question established notions of verbal memory restricted to the left hemisphere.
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C. McMILLAN, R. CLARK, P. MOORE, L. MONETA, C. DeVITA, & M. GROSSMAN. The Neural Basis for Generalized Quantifiers.
A generalized quantifier like "every" is formally a function from sets to truth values; informally, it is a description of a quantity or an amount. The semantics of quantifiers are well understood yet we know little about their neural representation. Our model of quantifier processing includes a numerosity device, operations that combine number elements, and working memory. Semantic theory posits 2 types of quantifiers: First-order identifies a state (e.g., "at least 3"), and higher-order requiring the retention of a state for comparison with another state (e.g., "less than half"). We used fMRI to test that all quantifiers recruit brain areas associated with numerosity while only higher-order quantifiers recruit executive resources. Six young adults saw a written proposition including a quantifier, followed by a collection of 8 objects. Subjects made truth verification judgements of the object array based on the proposition. SPM99 identified regions exceeding height ($p < .001$ uncorrected for multiple comparisons) and extent (>20 voxels) statistical thresholds. First-order quantifiers recruited left posterolateral temporal and bilateral occipital cortex. Higher-order quantifiers also recruited left posterolateral temporal and occipital cortices, and additionally activated left inferior parietal, bilateral anterior cingulate, and dorsal aspects of left inferior frontal cortex. Direct contrasts associated right posterolateral temporal-parietal activation with first-order quantifiers but left inferior parietal, right parietal-occipital, left dorsal inferior frontal, and anterior cingulate with higher-order quantifiers. These findings support our model, showing parietal support for numerosity in all quantifiers, and dorsal inferior frontal and cingulate support for executive resources only with higher-order quantifiers.
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K.Y. HAALAND, S. RAO, A. MAYER, & S. DURGERIAN. fMRI Verification of Left Hemisphere Dominance for Motor Sequencing.
Studies in brain damaged patients strongly support left hemisphere dominance for controlling a wide variety of ipsilateral movements, especially motor sequencing. Functional MRI studies have examined hemispheric asymmetry of motor sequencing, but these studies are contradictory and have not attempted to examine the type of sequences that are impaired after left hemisphere damage. This study utilized simple (5 repetitive button presses with the same finger) and complex (e.g., index, middle, index, ring, index finger) sequences, which were impaired in left hemisphere damaged patients. Normal right handers performed sequences with the right or left hand in a blocked design while fMRI was recorded. The expected contralateral motor cortex activation was seen. However, when the areas that were activated for both hands and for both sequence types (RC + LC, RS + LS) were identified, the volume of activation in the left hemisphere was greater than the right hemisphere, and the left hemisphere activation did not include the motor cortex. The increased volume of activation was associated with additional activation in the same areas (premotor and parietal areas) that were activated in the right hemisphere, rather than activation of unique areas. Complex sequences produced differential activation of the superior parietal lobe and the left inferior parietal lobe. These results support left hemisphere dominance for motor sequencing and emphasize the role of cortical association areas in that dominance.
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J. DeLUCA, C.E. MYERS, M.T. SCHULTHEIS, G.M. SCHNIRMAN, B.J. DIAMOND, & M.A. GLUCK. Impaired Delay Eyeblink Classical Conditioning After Anterior Communicating Artery Aneursym.
Individuals who survive aneurysm and rupture of the anterior communicating artery (ACoA) often present with an anterograde amnesia syndrome which is superficially similar to that observed in individuals with damage to the hippocampus and associated medial temporal lobe structures. It is currently believed that ACoA amnesia results from basal forebrain damage, which in turn may lead to disrupted hippocampal processing in the absence of direct hippocampal damage. Converging evidence from animal studies and computational modeling suggests that subtle but qualitative differences may exist in the pattern of memory impairment following basal forebrain *versus* hippocampal damage. For example, animals with basal forebrain but not hippocampal damage are impaired in a delay eyeblink classical conditioning paradigm. In the present study, delay eyeblink classical conditioning was examined in 6 amnesic ACoA subjects and 6 healthy control subjects matched for age and education. Relative to matched controls, the ACoA group showed significantly impaired delay eyeblink conditioning. This result is consistent with the animal studies following basal forebrain damage. However, the impaired delay eyeblink conditioning in ACoA subjects contrasts with the previously observed intact delay eyeblink conditioning among mesial temporal amnesics. The present findings suggest a possible dissociation of the memory impairment observed in medial temporal versus basal forebrain amnesia.
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M.E. McCOURT, J. J. FOXE, & D.C. JAVITT. Parietal Control of Spatial Attention: A High-Density ERP Study of Line Bisection.
In line bisection tasks, patients with lesions of right temporo-parietal cortex often misbisect lines far rightward of center. Normal subjects misbisect lines with a systematic leftward bias (i.e., show pseudoneglect). Neuroimaging studies in normals reveal predominant right hemisphere activation during tasks engaging visuospatial attention, including line bisection. The aim of the current study was to confirm parietal activation in visuospatial processing, and reveal its temporal dynamics. Subjects (N = 9) participated in two conditions of a tachistoscopic forced-choice line bisection task involving judgments of either transector spatial location (attention task), or transector presence/absence (control task). Continuous EEG was concurrently acquired from 128 scalp electrodes. Subtraction procedures (attention task–control task) were used to compute ERP's. An electrophysiological correlate of pseudoneglect was disclosed, characterized by a triphasic series of negative potentials over right hemnisphere structure with a latency range of 170–400 ms poststimulus. A negative focus first emerged (160–190 ms) at the right temporo-occipito-parietal (TPO) junction, and was joined next (190–240 ms) by a second focus over the right central parietal scalp. In the final phase (310 ms), the TPO focus diminished while the central parietal focus persisted for an additional 70–100 ms. A highly significant electrophysiological signature for normal visuospatial asymmetry (pseudoneglect) was found, implicating right hemisphere structures (TPO and parietal cortices), and revealing the temporal dynamics of visuospatial processing within these structures.
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Symposium 17/11:00 a.m.–12:45 p.m.

PERSPECTIVES ON REHABILITATION OF INDIVIDUALS WITH COGNITIVE IMPAIRMENT AFTER BRAIN INJURY: WHERE ARE WE 20 YEARS AFTER THE DEBATE BEGAN?

Organizer: Robin Hanks
Chair: Leslie Gonzalez-Rothi

R.A. HANKS. Perspectives on Rehabilitation of Individuals with Cognitive Impairment After Brain Injury: Where Are We 20 Years After the Debate Began?
At its meeting in Chicago in February 1995, the Joint Committee on Interprofessional Relationships for the American Speech, Language, and Hearing Association (ASHA) and Division 40 (Neuropsychology) of the American Psychological Association decided to develop a statement concerning the cognitive rehabilitation for persons with brain injury. The primary goal of this collaborative process was to encourage careful theoretical reflection and empirical investigation consistent with available research data, relevant theory, clinical experience, and trends in service delivery and reimbursement. In 2001, this statement was complete and endorsed by parent organizations. This symposium provides an overview of the statement developed by this interprofessional committee, as well as discussion regarding the viability and future directions of cognitive rehabilitation by some of leading authorities that have been involved in the historical debate on this topic. The symposium will cover a wide range of topics related to cognitive remediation, including (1) the consideration of goal planning as compared to neuropsychological testing to structure and evaluate cognitive rehabilitation, (2) specified cognitive interventions that may be appropriate to cognitive rehabilitation, and (3) a comparison of the dilemma and debate on cognitive remediation to other medical interventions and how such medical issues were resolved. The discussants represent a multidisciplinary group of individuals including clinicians and researchers, as well as neuropsychologists and speech and language pathologists, that will present both clinical and empirical findings and will discuss how these findings relate to the statement presented by the interprofessional committee.
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M. YLVISAKER, R. HANKS, D. JOHNSON-GREENE, et al. Perspectives on Rehabilitation of Individuals with Cognitive Impairment After Brain Injury: Rationale for Reconsideration of Theoretical Paradigms.
For over 20 years, cognitive rehabilitation has been a widely delivered, but increasingly controversial service in brain injury rehabilitation. By the late 1990s, studies and reviews of published studies of the effectiveness of cognitive rehabilitation delivered within the traditional paradigm were disproportionately negative, resulting in a growing crisis of funding and other supports for the service. As a response to this relatively unpromising evidentiary environment, a joint committee of the American Speech Language and Hearing Association and Division 40 (Neuropsychology) of the American Psychological Association chose to review conceptual frameworks for cognitive rehabilitation. This effort resulted in a paper designed to articulate 2 distinct paradigms for the service, outline a rationale for each, and call on researchers and practitioners to redouble their efforts to create a solid theoretical and empirical foundation for their intervention efforts. In this presentation, I will briefly outline the 2 paradigms: (1) The traditional paradigm, associated with a theory of cognition as composed of dissociable components that can be independently targeted with restorative cognitive exercises or compensatory procedures; (2) A contextualized paradigm, compatible with several theories of cognition, including the sociohistorical theory of Vygotsky and Luria, and organized around the patient's contexts of activity, whether the ultimate target of intervention is at the level of participation, activity, or underlying impairment. I will describe strengths and weaknesses of each paradigm, and attempt to contribute to the growing debate over evidence-based practice in cognitive rehabilitation by summarizing results and meta-analyses of hundreds of studies in related fields of disability with a longer history of research than is available in neuropsychological rehabilitation for individuals with traumatic brain injury. I will include a discussion of advantages and dangers of apparent cross-population inferences.
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C. MATEER. Specified Cognitive Interventions: Their Role in Best Rehabilitation Practices.
Contrary to the spectre of brain-injured clients sitting bleary eyed in front of computerized cognitive rehabilitation tasks, best practices have always emphasized a client-centered, outcome focused approach to cognitively impaired patients. Therapists rarely, if ever, "wait to see" what cognitive functions may be restored before implementing and training appropriate functional compensations, although recent research in motor and sensory recovery suggest caution even in this approach. The question has always been what is "value added" by incorporating into rehabilitation practices and activities a focus on specific cognitive systems. While certainly not appropriate or effective for every patient, cognitively oriented training can result in improvements in function, and can help to increase awareness and self-regulated accommodation to cognitive impairment. To date, the specific practices that are purported to be instrumental in a strictly functional approach, guided and supported experience, urged by Ylvisaker, Park and others, have simply not been well enough specified and have not been subjected to the same scrutiny and "standards" as have cognitively oriented interventions. This presentation will review recent relevant research in neuroplasticity, guided recovery, and cognitive rehabilitation that address these important issues. Also presented will be the results of 2 studies, each of which compares and contrasts cognitive, electrophysiological, emotional, and functional outcomes associated with a supported functional approach *versus* a cognitive training approach using crossover treatment designs. These studies suggest that different, but mutually valuable, outcomes are achieved from the 2 approaches. Knowledge about

how individuals engage various cognitive abilities and how they best learn, must remain a cornerstone of rehabilitation practices.
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B. WILSON. Goal Planning Rather Than Neuropsychological Tests Should Be Used to Structure and Evaluate Cognitive Rehabilitation.
Many studies of cognitive rehabilitation use neuropsychological tests to plan and evaluate treatment. This paper suggests that this is not a good rehabilitation procedure. The main purposes of rehabilitation are to achieve the maximum physical, psychological, social, and vocational well-being of each individual and to enable people to return to their own, most appropriate environment. We do not engage in rehabilitation in order to help people achieve better scores on tests. This might be acceptable if there was a direct relationship between test scores and real life problems but there is not such a relationship. Although tests are useful in providing a picture of strengths and weaknesses, they are extremely limited in identifying everyday disabilities and handicaps. People can lead improved lives by compensating for or bypassing some of their cognitive problems, yet remain unchanged on test scores. Conversely, they can improve on test scores yet remain severely handicapped in everyday life. One approach that is gaining ground in rehabilitation is goal planning. This allows patients/clients, their relatives, and rehabilitation staff to negotiate appropriate and meaningful goals, determine how these should be achieved, and measure success or failure in real life situations. Goal planning both reduces the artificial distinction between rehabilitation practice and outcome measures, and allows the integration of theory and practice. The processes and procedures involved in goal planning are described and followed by an evaluative discussion. The paper concludes with examples of goal planning in clinical practice.
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K. ADAMS. Realizing the Potential of Cognitive Treatments for the Brain Injured: Next Steps.
The Joint Committee of ASHA and Division 40 have jointly issued an important summation and aspirational document concerning the rehabilitation of patients with brain injury. The most striking feature is its "move towards the middle" in attempting to blend theoretical and empirical concerns and issues. The tension between trying to retain the purist experimental elegance, attempting to generalize effects, and creating programs that have a realistic chance to demonstrate efficacy is reflected in the recommendations offered in the document. This presentation will examine some examples of parallel dilemmas in some other medical interventions wherein practical trade-offs in these realms turned out to be either wise or the undoing of the treatment. In addition, the standing of this family of interventions as belonging to several possible medical and nonmedical tribes such as psychiatry, physical medicine, psychology, or even primary care is examined with potential advantages and pitfalls.
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Symposium 18/11:00 a.m.-12:45 p.m.

ADVANCES IN EXECUTIVE FUNCTION ASSESSMENT: INNOVATIVE APPROACHES TO COMPLEX BEHAVIOR

Organizer and Chair: Paul J. Eslinger

P. ESLINGER. Advances in Executive Function Assessment: Innovative Approaches to Complex Behavior.
This symposium is organized to present new approaches to assessment of complex behavior, particularly executive and self-regulatory processes. These domains present tremendous challenges to our field, including clearly operationalized constructs, reliable and valid assessment, as well as management and rehabilitation applications. The presentations convey three different approaches which contrast markedly with the highly structured tasks often employed in neuropsychological assessment. Yet, each approach adheres to standardized administration, quantitative measurement of strategy, planning, and decision-making, with reliable and valid procedures. Levine describes such an approach to assessment of self-regulatory disorder, emphasizing the revised Strategy Application Test. This procedure has been validated in diverse patient samples and appears sensitive to the self-regulatory processes involving the ventral prefrontal cortex and manifest in real-world outcome after brain injury. Satish outlines an approach to executive function assessment that builds upon a reliable and valid simulation paradigm for decision-making and planning that has evolved in the cognitive science literature for many years. Performance indicators are predictive of not only simple action plans, but also alternative and sequenced actions, and overall success of executive functioning in real-world settings. Finally, Tranel describes a comprehensive approach to the complex domain of social conduct that draws upon assessment of cognitive risk-taking behaviors, autonomic responsiveness, emotional processing, and personality. Findings are illustrated in patient samples with ventromedial prefrontal cortex damage, shedding new light on the mechanisms that affect adaptation within real-world settings. These approaches, among others emerging in neuropsychology, will be further compared and contrasted in discussion.
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B. LEVINE. Novel Approaches to the Assessment of Prefrontal Brain Damage Effects: The R–SAT Studies.
The prefrontal cortex is involved in self-regulation, including decision making, inhibition, and strategy application. Damage to these regions causes self-regulatory disorder (SRD) in which behavior in unstructured situations is not governed by internal goals or constraints. Performance on externally structured tasks, however, is often preserved. Traditional clinical neuropsychology fails to capture the substantial real-life disablement caused by SRD. Although this shortcoming has long been recognized, it is only in the past decade that researchers have sought to quantify these deficits with novel laboratory tasks. The Revised Strategy Application Test (R–SAT) is a paper-and-pencil test that mimics the real-life situations that pose problems for patients with SRD. The R–SAT has been validated in 3 populations: patients with focal frontal lesions, frontotemporal dementia, and traumatic brain injury. The findings support clinical and experimental observations of the preferential role of the ventral prefrontal cortex in self-regulation. Self-regulation as assessed by this measure is dissociated from the other processes, such as output monitoring and memory for task instructions. It is further significantly related to real-life outcome as measured by significant others' ratings of patients' behavior. Data from the R–SAT and other paradigms underscore the need for novel assessment techniques for patients with prefrontal damage.
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U. SATISH & S. STREUFERT. Strategic Management Simulation: Assessment of Planning and Complex Decision-Making.
Strategic Management Simulation (SMS) provides a standardized methodology to evaluate complex thinking, planning, and performance capacities. It has been developed over 30 years, drawing on the cognitive science literature and complexity theory. It is predictive of successful executive functioning in the "real world" outside the laboratory, whether in managing day-to-day tasks or various vocational demands. Data are collected during simulation of a real-world-like task where the participant engages in self-generated sequential actions, planning strategies and response to unanticipated situations. The SMS method provides more than 80 measures of functioning, loading across culture on 12 reliable factors. Execu-

tive functioning is reflected in such measures as activity, timeliness of response, information handling, initiative, sequential planning, strategy, flexibility, and breadth of approach. The simulation assesses how an individual handles multiple task components during routine conditions and nonconditions of complexity, change, and uncertainty. Application of SMS procedures to assessment of neurological patients is relatively new. Initial findings appear promising for extending the range of executive-type processes that can be evaluated under standardized conditions that yield reliable and valid quantitative data. The largest group studied to date is closed head injury (CHI) subjects with very good recovery from deficits but lingering complaints about their effectiveness in community and vocational settings. While their neuropsychological test scores typically are unrevealing, SMS procedures show that CHI subjects become overfocussed on one salient problem, ignoring concurrent concerns. They are inefficient in their information handling capacities, often searching for information but applying it sparingly in decision-making. Initiative, activity and breadth, and timeliness of decision-making are also poor relative to controls. Results are further discussed in light of possible remediation approaches.

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D. TRANEL, A. BECHARA, & N.L. DENBURG. Asymmetric Functional Roles of the Right and Left Sectors of the Ventromedial Prefrontal Cortices in Social Conduct, Decision-Making, and Emotional Processing.

This study tested the hypothesis that the right-sided component of the ventromedial prefrontal cortex (VMPC) is a critical component of prefrontal systems subserving social conduct, decision-making, and emotional processing, and, in corollary fashion, that the left-sided component of the VMPC is *not* a critical component of these systems. Seven participants with focal, stable unilateral lesions to the left ($n = 3$) or right ($n = 4$) VMPC were studied. We used a set of specially developed assessment procedures, which overcome many of the limitations of traditional laboratory methods of measuring constructs such as "decision-making" and "social conduct." The new methods included the Iowa Gambling Task (done in conjunction with measurement of skin conductance responding) and the Iowa Rating Scales of Personality Change (which provide criteria for diagnosing "acquired sociopathy"). Conventional neuropsychological assessment indicated that most of the participants in both the left and right groups had normal cognitive profiles. In sharp contrast, profound disturbances of social and interpersonal behavior were frequent in the right-sided VMPC cases; also, most of these participants were completely unable to secure and maintain gainful employment. Social/interpersonal deficits were rare in the left-sided cases, and all of these participants were successfully employed. The right VMPC participants had defective performance on the Gambling Task (disadvantageous choices), whereas the left VMPC participants had a normal performance (advantageous choices). In addition, the right-sided cases had impaired anticipatory skin conductance responses during the Gambling Task, whereas the left-sided cases were normal. Finally, most of the right-sided cases had profound abnormalities of emotional processing, and most met criteria for the characterization of "acquired sociopathy." This was not true of the left-sided cases, whose emotional processing and personalities tended to be normal and unchanged from their premorbid status. In sum, a careful contrast of unilateral left versus right VMPC participants, using a set of specially developed experimental procedures, revealed that the right-sided cases tended to have severe deficits in social conduct, decision-making, and emotional processing, deficits that are reminiscent of those that have been reported in connection with bilateral VMPC lesions. By contrast, participants with left-sided VMPC lesions did not tend to manifest such deficits. The findings suggest that the right and left components of the VMPC make very asymmetric contributions to social conduct, decision-making, and emotional processing, with the right side being far more critical for these functions.

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